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

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

Vol. 5, No. 4, July-September 2012

Contents

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Mechanical

- **I. S. Machines** (Single to 10 sec; Mechanical I Electronic)
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- **Gear Driven Revolving *Tube Mechanism*** *upto 10" tube.*
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  (ii) **I.S.m/c** : **SG** to **DG** & Vice Versa

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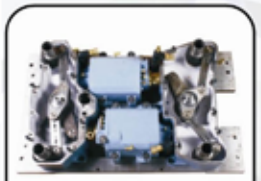
Quick Change Plunger Mechanism Parts

Quick Change Variables

T. G. Variables



Oil-immersed MOC linkage

Piston Rod, Rack, Spline Shaft

Feeder Mech.

Delivery Equipments

Hinge Back-up Variable

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Constant Cushion Invert & Take Out Cartridges

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Sep 2012

From President's Desk

After completing my term as President of the AIGMF I am pleased to welcome Mr. S.C. Bansal as the President of the AIGMF.

With the help of other office bearers and the AIGMF Secretariat, the most important task which has been completed was bringing back flat glass manufacturers in the fold of the AIGMF. The Architectural Glass Panel (AGP) has been constituted within the aegis of the AIGMF to promote the cause of Float Glass Industry in India.

Another important task completed was Life Cycle Assessment (LCA) study of glass containers, perhaps done for the first time by any Association in Asia. The study shows that glass containers are the most ecofriendly packaging medium.

For the first time an AIGMF delegation visited China Glass in May 2011.

To generate interest amongst members the AIGMF Secretariat organized seminars and presentations concurrent with meetings of the Executive Committee.

With a view to provide world class reading material to members and other readers of Kanch – "Glass Worldwide" was made Preferred International Journal of AIGMF and "Asian Glass" as "Official Information Provider" to AIGMF for its quarterly Journal KANCH.

I am sure Mr. Bansal and his team will attain further heights. I assure my full support and cooperation to the new team.

I will like to express my thanks to my colleagues, office bearers of the AIGMF, for their cooperation. My thanks are also due to members of the Federation and the Secretariat for their untiring efforts in organizing various programmes.

I wish all the best to the new team and the Federation

Mukul Somany
President
and Vice Chairman and Managing Director
Hindusthan National Glass and Industries Ltd.

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. Western India Glass Manufacturers' Association-Mumbai, Eastern India Glass Manufacturers' Association-Kolkata, U.P. Glass Manufacturers' Syndicate-Firozabad, Northern India Glass Manufacturers' Association-Sahibabad, Ghaziabad (UP) and South India Glass Manufacturers' Association-Hyderabad. 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:-

a) 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.
b) To form a common link amongst Glass Manufacturers' in India and thus develop a spirit of mutual help and co-operation with one another.
c) To promote the study and research in Glass Technology.
d) To consider all matters relating to the manufacture and marketing of glass articles in India and the question of export and import thereof.
e) 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.
f) To collect necessary information and data and propagate it for the benefit of Glass Industry and trade in India.
g) To make representations whenever necessary to the Union Govt. 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.
h) 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.
i) 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.

Secretary AIGMF

GLASS NEWS INDIA

AIGMF Executive Committee Meet and Annual General Meeting

The Executive Committee Meet and Annual General Meeting were held at Casurina Hall, India Habitat Centre, New Delhi on September 29, 2012.

Apart from normal agenda and proceedings, highlight of the day was election of President and office bearers for the year 2012-13. Following were unanimously elected in the Annual General Body Meeting:

President – Mr. S.C. Bansal
Adarsh Kanch Udyog, Firozabad (Uttar Pradesh)

Post-graduate in Commerce from Agra University started trading in glass and soon went in to manufacturing of glass bangles and then to a wide range of products including glass table and lamp wares.

His journey has been creative keeping up with realities in the industry. His quality of creativity inspires everyone.

S.C. Bansal
Incoming President
of the AIGMF

Sr. Vice President – Mr. Sanjay Ganjoo
Asahi India Glass Ltd., Taloja (Maharashtra)

A Mechanical Engineer; joined Asahi India in 1989 and is currently working as COO of architectural glass business.

Vice President – Mr. Arun Kumar D
AGI Glaspac (An SBU of HSIL Ltd), Hyderabad

Graduate in Mechanical Engineering. Commenced career as Graduate Engineer in 1971 in Steel Authority of India Ltd.

Working with AGI glaspac (An SBU of HSIL Ltd) for 20 years as President in the Container Glass Unit. Visited many countries across the Globe in connection with technical collaboration, transfer of technology & business development.

Hony. General Secretary – Mr. Ajit Jhunjhunwala
La Opala RG Ltd., Kolkata

Commerce Graduate from St. Zaviers College, Kolkata is Deputy Managing Director, La Opala Rg Ltd. 20 years' experience in the Glass industry. Also, former President of Eastern India Glass Manufacturers' Association.

Hony. Treasurer – Mr. Bharat Somany
HNG & Inds. Ltd., Bahadurgarh (Haryana)

A Bachelor of Commerce (Honours) graduate from University of Delhi with a professional course in Management from the Indian Institute of Management, Ahmedabad and multifarious hands-on training in the glass industry from various leading companies around the world (Germany, Italy, USA & Japan).

Apart from association with Hindusthan National Glass & Industries Limited, Executive Director at Glass Equipment (India) Limited, an engineering unit of HNG & Industries Limited.

Executive Committee Meet

Outgoing and Incoming Office bearers of the AIGMF

Executive Committee Members

Secretary announced names of members of Executive Committee of the AIGMF for the Year 2012-13:

Mr. Mukul Somany - outgoing President

NOMINEES OF WESTERN INDIA GLASS MANUFACTURERS' ASSOCIATION

1. Mr. H.R.Bhandari - Pragati Glass Pvt. Ltd., Mumbai
2. Mr. G.K. Sarda - Empire Ind. Ltd., Vitrum Glass, Mumbai.
3. Mr. Vijay Shah - Piramal Glass Ltd., Mumbai.
4. Mr. Sanjay Jain - HNG & Industries Ltd., Mumbai
5. Mr. Hasmukh - M. Thakkar Sunrise Glass Industries (P) Ltd.

NOMINEES OF EASTERN INDIA GLASS MANUFACTURERS' ASSOCIATION

1. Mr. Dinesh - Jhunjhunwala Ashoke Enamel & Glass Works P. Ltd., Kolkata
2. Mr. Sushil - Jhunjhunwala La-Opala RG Ltd., Kolkata

NOMINEES OF U.P. GLASS MANUFACTURERS' SYNDICATE

1. Mr. Mohan Lal - Agarwal General Traders, Firozabad
2. Mr. Devicharan - Agarwal Pooja Glass Works (P) Ltd., Firozabad
3. Mr. Raj Kumar - Mittal Mittal Ceramics, Firozabad
4. Mr. Sanjay Agarwal - Kwality Glass Works, Firozabad
5. Mr. N.P. Mittal - Meera Glass Industries, Firozabad
6. Mr. Sanjay Mittal - Nannumal Glass Works, Firozabad

NOMINEES OF SOUTH INDIA GLASS MANUFACTURERS' ASSOCIATION

1. Mr. Sandip Somany - AGI Glaspac (An SBU of HSIL Ltd.), Hyderabad.

NOMINEES OF NORTHERN INDIA GLASS MANUFACTURERS' ASSOCIATION

1. Mr. S.C. - Vishwakarma Universal Glass, Sahibabad
2. Mr. N.N. Goyal - U.P. Twiga Fiber Glass Ltd., New Delhi

The following were co-opted as members of the Executive Committee for the year 2012 – 2013:

1. Mr. C.K. Somany - HNG & Ind. Ltd., Kolkata
2. Mr. Balkrishan - 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. Sanjay Labroo - Asahi India Glass Ltd.,

Release of Indian Glass Directory 2012

(Ex-Presidents)

(L to R) Mr. P K Kheruka, Vice Chairman, Gujarat Borosil Ltd.; Mr. Sushil Jhunjhunwala, Managing Director, La Opala RG Ltd.; Mr. Pradeep Kumar Gupta, CMD, Om Glass Works (P) Ltd.; Mr. C K Somany, Chairman, Hindustan National Glass & Industries Ltd., and Mr. S C Vishwakarma, Vice President, Universal Glass released the Indian Glass Directory 2012 at office of the AIGMF in New Delhi on August 20, 2012

The All India Glass Manufacturers' Federation (AIGMF) and Asian Glass sign landmark agreement

AIGMF has appointed Asian Glass as "Official Information Provider" for its quarterly journal KANCH. In this way AIGMF and Asian Glass magazine will exchange information related to Glass Industry.

By tying up with Asian Glass, our member companies will benefit more directly from the quality of market information it provides."

"We are delighted to have signed such an important agreement with the AIGMF" said Andy Skillen, Managing Director of Bowhead Media Ltd, the publisher of Asian Glass. "We see this as a great opportunity to disseminate even more valuable market information to the industry, and look forward to continuing our close links with the sector as a result."

OBITUARY

Mr. Rajinder Singh, a veteran of glass industry and former President of the AIGMF & Director, Empire Industries Ltd. – Vitrum Glass, Mumbai left for heavenly abode on 30th July, 2012.

With grief and sorrow: AIGMF President, Office Bearers, Members and Secretariat.

INVESTMENT OPPORTUNITIES AND ENERGY CONSERVATION IN GLASS INDUSTRY

Event held at India Habitat Centre, New Delhi on September 29

AIGMF organised a seminar on Investment Opportunities and Energy Conservation in Glass Industry along with its Executive Committee Meet and Annual General Meeting at Casurina Hall, India Habitat Centre, New Delhi on September 29, 2012.

Presentations by Mr. Dinesh Menon, CRISIL (*Credit Rating and Information Services of India Ltd.*) Risk and Infrastructure Solutions Limited on Investment Opportunities in Rajasthan-Ceramics and Glass Complex at Giloth, Rajasthan by RIICO- (*Rajasthan State Industrial Development & Investment Corporation Ltd.*) was followed by presentation by Mr. C S Madan, (GAIL) Gas Authority of India Ltd., on Natural Gas and its Benefits.

It was explained that Rajasthan State Industrial & Investment Corporation (RIICO), a state agency, plans to set up a Glass and Ceramics complex at Giloth, Rajasthan. The complex, covering an area of 750 acres, will

be set up for Glass & Ceramics based Industries.

Presentation by CRISIL covered Project profile, Manufacturers interest and suggestions. The participants were informed about the special incentive package and subsidies for the promotion of Glass & Ceramics sector.

GAIL's presentation focused on demand for energy in India, Indian gas sector overview, gap between domestic supply/demand and existing / additional upcoming pipeline infrastructure in India with special focus for laying gas pipeline at Glass Complex at Giloth and entire Rajasthan area.

Around 55 participants from Glass and related Industries participated in the interactive session.

Complete presentations can be downloaded from http://aigmf.com/past-events.php

Introduction of Company Profile in KANCH

From Oct-Dec 2012 issue a special feature – Company profile is being introduced in Kanch. This will contain an interview of Managing Director /Proprietor of the company or their nominee by an expert and will be published in KANCH along with photograph of the person interviewed as also the factory.

For availing this offer on first-come-first serve basis please send mail to info@aigmf.com

Advertise in KANCH

Kañch is the leading choice for advertising in the glass and related industries. With several years publishing experience, unrivalled coverage for the worldwide glass manufacturing community with up-to-date news, editorial and features, as well exhibitions; KANCH is the best medium to communicate with stakeholders

We understand your needs as an industry and are committed to assist you in making your advertising most profitable. This also popularises your brand and product portfolio by establishing contacts to suit your company's requirements.

Good quality advertisement material in high resolution along with a Demand Draft / Cheque of the requisite amount – payable to 'The All India Glass Manufacturers' Federation' at New Delhi may be sent to Secretary AIGMF at the registered office of the Federation.

It would be ideal if you could send your advertisement in PDF high resolution format (with auto enabled e-mail ID / website address, if any) helping readers to reach you directly on a single click in KANCH's e-version / AIGMF website.

A complimentary copy of KANCH along with the invoice will be sent to all advertisers. Those wanting more than one copy are requested to send their request in advance.

Advertisement Tariff:

	Indian Companies (₹)	Foreign Companies (US$)
Ordinary full page	8000	450
Extra Inside Cover Page	9000	500
Inside Cover Page	10000	525
Back Cover Page	20000	700
Front Cover Page	25000	1000
Centerspread (two pages)	20000	900
Half Page	5000	300

The print area is 21 x 30 cm for full page advertisement and 21.5 x 21.5 cm for the glossy front-cover four colour advertisement

Foreign companies are requested to send the Demand Draft of the requisite amount in US Dollars. Demand Draft be made in the name of 'The All India Glass Manufacturers' Federation', New Delhi.

For convenience, payment can also be remitted through wire transfer. Our bank details are as under:

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026 005 322, giving full particulars of Beneficiary i.e.

Account No. : 05860400000062
Name : The All India Glass Manufacturers' Federation
Bank : Bank of Baroda
Branch : Parliament Street
City : New Delhi, India

Payment Instruction Message i.e. MT - 103 is to be sent to Bank of Baroda, IBB, New Delhi, SWIFT BIC - BARBINBBPAR

Remittance from India to:

(deposit cash or make NEFT- online payment)

Account No. : 000701239715
Name : The All India Glass Manufacturers' Federation
Bank : ICICI Bank Limited
Branch : 9A, Phelps Building, Connaught Place, New Delhi
IFSC Code : ICIC0000007

A copy of bank advice may please be sent to AIGMF Secretariat for reconciliation.

THEORETICAL STRENGTH FOR BRITTLE GLASSY MATERIALS

A. K. Bandyopadhyay
Ex-President of Indian Institute of Ceramics,
Technology Consultant & Ex-Principal,
Govt. College of Engg. & Ceramic Technology,
W. B. University of Technology, Kolkata

Abstract

By changing the limit of integration within the zone where fracture occurs in brittle glassy materials, based on a sinusoidal approximation as used in the Griffith formulation of theoretical strength of such solids, a modification of the equation for theoretical strength can be achieved. This modified equation for theoretical strength has been developed using the linear Hook's law near to the maximum of applied stress by taking a small variation in the spatial elongation. This equation gives rise to a multiplication factor, which has to be used to predict the theoretical strength when micro-flaws are present in the glassy materials. This theoretical result is discussed in terms of the available data on fused silica and other materials that are used in the glass industry.

Key words: Griffith equation, Theoretical strength, Hook's law, Fused silica.

Introduction

In a previous article on float glass technology in *Kanch* [1], apart from various chemical aspects, the problem of thickness variations was discussed. However, the mechanical properties in terms of fracture of such glasses are also of great importance, since these glasses are mostly used in the building industry and façade decoration purposes, wherein fracture in any form can cause damage to the installation that will result in a loss to the investment made. Although the present article deals with the problem of fracture in brittle materials, such as glasses, the importance has to be given for float glasses, as these glasses have aesthetic appeal with the highest quality requirements so far the glass industry is concerned.

There has been a tremendous amount of work done in the field of fracture mechanics in brittle materials and glasses, particularly on their theoretical strength for a long time [2 – 8]. This is mainly done on Griffith equation based on the formation of an elliptical crack and its main plank is the utilization of material parameters or constants, which are measurable, in designing suitable materials for various important applications [2]. An insight should be obtained on the nature of theoretical strength based on a sinusoidal approximation in the stress vs. spatial elongation curve (see Fig. 1 in the next section for clarity). In the context of this approximation, in the present article, our main focus is on the "fluctuation" of the spatial elongation value at or near fracture so that a modified equation can be developed to better predict the theoretical strength of glasses.

Although the subject of much research over the past decades, the fracture of brittle glassy materials remains in many ways not understood. Of particular interest is the mechanism by which energy in the system is dissipated. Experimental measurements

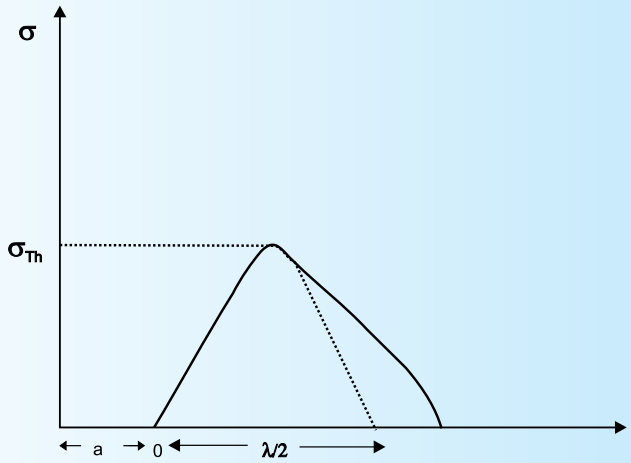

Fig. 1: Stress *vs*. elongation curve with sinusoidal behavior

of the flow of energy into the tip of a running crack have indicated that the fracture energy (i.e., the energy needed to create a unit extension of a crack) is a strong function of the crack's velocity and that the majority of the energy stored in the system prior to the onset of fracture ends up as heat. An example of the fracture of soda-lime-silica glass has been taken into consideration. Residual stress profiles were introduced in sodium aluminosilicate glass disks using an ion-exchange process, i.e. after chemical strengthening. They were fractured in two loading conditions: indentation and biaxial flexure. The fractal dimension of the macroscopic crack branching pattern called the crack branching coefficient (CBC), as well as the number of fragments (NOF) were used to quantify the crack patterns. The fracture surfaces were analyzed to determine the stresses responsible for the crack branching patterns. The total strain energy in the body was calculated. The CBC was a good measure of the NOF. They are directly related to the tensile strain energy due to the residual stress profile for fractures due to indentation loading. However, in general for materials with residual stresses, CBC (or NOF) is not related to the strength or the stress at fracture, or even to the total stored tensile strain energy. A study was done to determine the geometric characteristics associated with the critical crack caused by cyclic loading in baria sillicate glass [9] (see the references therein for other useful references). Next, we show the theoretical side of the story.

Theoretical Development

The theoretical strength (σ_{Th}) of a 'body' is the stress required to separate it into "two parts", with the separation taking place simultaneously across the cross-section. To estimate σ_{Th}, let us consider 'pulling' on a cylindrical bar of unit cross section. The "force of cohesion" between the two planes of atoms varies with their separation, after the inter-atomic spacing (a):

$$\sigma = \sigma_{Th} \sin(\frac{2\pi X}{\lambda}) \quad (1)$$

A part of the curve is approximated by the sinusoidal relation [3], as shown in Fig. 1. This equation represents the so-called governing equation of stress (σ) against the spatial elongation (X). The work per unit area to separate the two planes of atoms is then calculated by the integral of the curve between X = 0 and X = $\lambda/2$:

$$\int_0^{\lambda/2} \sigma_{Th} \sin(\frac{2\pi X}{\lambda}) dX = \sigma_{Th}(\frac{\lambda}{\pi}) \quad (2)$$

This work or energy is then equated with the surface energy (2γ) of the two newly created surfaces that give rise to $\sigma_{Th} = (\frac{2\pi\gamma}{\lambda})$ for the initial part of the curve near the equilibrium spacing (a), as in Fig. 1. As we know, from the Hook's law that $\sigma = E(\frac{X}{a})$, where, E = Young's modulus. At this small part of X of this curve, from Equation (1), the following relation has been deduced:

$$\int_0^{\lambda/2} \sigma_{Th} \sin(\frac{2\pi X}{\lambda}) dX = \sigma_{Th}(\frac{\lambda}{\pi}) \quad (3)$$

This is done at X = 0. Equating this with the Hook's law i.e. $\sigma_{Th,} = (\frac{2\pi\gamma}{\lambda})$ we get the following:

$$\sigma_{Th} = (\frac{E\gamma}{a})^{1/2} \quad (4)$$

Typical values of E = 3 x 10^{11} dynes/cm^2, γ= 10^3 ergs/cm^2 and a = 3 x 10^{-8} cm, and σ_{Th} = 10^{11} dynes/cm^2 as per equation (4). If $\lambda \approx a$, then we can show σ_{Th} varies from E/5 to E/10. For window glass, the strength is 10^4 psi, σ_{Th} = E/1000, and for alumina ceramics, the strength is 5 x 10^4 psi, σ_{Th} = E/1000. It has to be noted here that alumina is an important component in the window glass composition, as suitable mechanical strength is desired by the consumers.

Therefore, between the theoretical predictions and the actual experimental values, there is a discrepancy, which needs to be solved. It should be mentioned that involving material's constants (E and γ) and half of the elliptical crack length (c), Griffith's criterion of the maximum strength at which the material fails on cracking is based on the above equation. Hence, this equation certainly merits careful attention. Moreover, in line with Griffith's concept of micro-flaw formation, the reduction of theoretical strength also merits further attention. Flaws in this kind of brittle glassy materials may not have the nature of classical Griffith micro cracks, but may rather take the form of embryonic defects with intensely concentrated residual stress fields [9,10].

In the above mathematical formulation, the limits of integration have been taken between 0 and λ/2, i. e. the work or energy is calculated upto a limiting point (i. e. λ/2) before which the material has already cracked, whereas linear Hook's law has been applied to the other end, i. e. at X = 0, when σ = 0. It should be clearly mentioned that the value of σ is maximum, which is the value of σ_{Th}, at X = λ/4.

In this theoretical development, we are inclined to take a 'small variation' around this value of X around λ/4. Let us assume that this variation is δ, i. e. the maximum strength can be assumed to be arrived at (λ/4). A brittle material cracks at or just after σ_{Th}, we can do the integration of equation (1) upto a limit of (λ/4 +δ) for the energy formulation in order to be able to be equated with the surface energy (2γ), instead of extending it upto λ/2, when the material or glass has already cracked or fractured. However, for linear Hook's law, it can be easily applied at (λ/4 −δ), when it is perfectly possible to differentiate σ at X = (λ/4 −δ), which was done at X = 0 as in equation (3). Therefore, the basic tenets of these two approaches are clear from the above. Under the above assumption, we find the total work done and equate with the surface energy of the newly created surfaces due to fracture. After some differentiation and mathematical workouts, we arrive at the modified Griffith equation as:

$$\sigma_{Th} = \sqrt{\frac{\frac{E\gamma}{a}}{\left(\frac{\pi\delta}{\lambda} + \frac{2\pi^2\delta^2}{\lambda^2}\right)}} \qquad (5)$$

Therefore, it is clearly seen that our above equation will put an incremental effect on the theoretical estimate of maximum strength with respect to a simple Griffith criterion $(E\gamma/a)^{1/2}$ involving the material parameters, with "a" replaced by half of the elliptical crack length. It is known for a long time that Griffith criterion of predicting and eventually designing the right materials, only through measurable material properties like surface energy (γ) and elastic modulus (E), has been very popular, since the equilibrium interatomic distance (a) is approximately known for glasses.

Results and Discussion

It should be pointed out that if we put δ/λ to be much less than 1/4, then it would be possible for us to predict the correct theoretical strength of brittle glassy materials. Therefore, this equation (5) can be used to precisely do this prediction by adjusting the value of δ/λ . For example, for three different values of δ/λ = 0.1, 0.01, 0.001, we have to multiply Griffith value (under the square root sign) with 1.40, 5.47 and 17.10 respectively. In the literature, very often, there is a factor of √2 in the Griffith's value. In the first case, our assumption of taking the value δ/λ = 0.1 gives rise to a multiplication factor of 1.40 (close to 1.414 = √2).

The above treatment will help us analyze a variety of materials with different values of the ratio of δ/λ (non-dimensional value) to fit the experimental value with that of the theoretical estimate. Since both the values of δ and λ are not measurable, it is always better to take a ratio to estimate the strength as per equation (5).

Let us take the example of a common glass, where the value of σ_{Th} is 14 GPa as per equation (4), but as the experimental values are always lower, Griffith [2] put forward a new equation of $\sigma = (2E\gamma/\pi L)^{1/2}$, where L = length of the micro flaws, which were considered to reduce the strength, as in many other brittle materials. As per this revised equation, Griffith [2] postulated that even micron (10^{-6} m) sized flaw could reduce the observed strength of the glass by a factor of 100. Thus, the ratio δ/λ is to be still lower, and the multiplication factor is higher. Actually, this ratio clearly dictates the presence of micro-flaws.

Finally, an example of fused silica is given here, as we normally try to understand its behavior with

that of float or other glasses. The parameters are: γ = 1.75 J/m2 and E = 72 GPa and taking a = 1.6 x 10^{-10} m, we find a theoretical value of strength as per equation (4) as 28.1 GPa, whereas the experimental value is 24.1 GPa. The close similarity of these values clearly indicates that it does not take the 'micro-flaws' into account. The theoretical value should be much higher. By multiplying the Griffith value with 1.40 (i.e. δ/λ = 0.1), we estimate the strength value as per equation (5) as 39.34 GPa. This discrepancy (or even more discrepancy) will actually justify the presence of the 'micro-flaws' in fused silica, which is a known fact [7, 10]. However, an analysis can be based on the estimated value of strength as 28.1 GPa.

As per the revised equation of Griffith involving micro-flaws, if we take the size (L) of the flaws at the quantum level, i. e. the value of "a" in equation (4), the theoretical strength goes down to 22.39 Gpa. As the size of the flaw increases to a level normally considered in the micron level, the value goes down by a factor of 100, i.e it becomes 0.2239, as also mentioned above. This necessitates the inclusion of the ratio δ/λ in the calculation of theoretical strength, which should also be in consonance with the data on fused silica on the probable flaw size.

The concept of micro flaws needs to be introduced, which is calculated from our equation (5) taking smaller values of δ/λ ratio. It is seen that as the level of micro flaws goes to a "usual" granular level, the value of δ/λ ratio becomes still smaller, and the need for a higher multiplication factor. It is pertinent to mention that although the data for fused silica are fitted here, the information given above can be obtained on a variety of other ceramic brittle materials in order to be able to explain the discrepancy between theoretical and experimental values of strength for effective design.

Here, we have calculated theoretical strength of different materials at the flaw size of 1.6×10^{-10} meter using the equation (4) and are trying to show that how theoretical strength of materials (σ_{Th}) changes with fluctuation ($\frac{\delta}{\lambda}$) as per Equation (5). It is always true to the fact that different materials have different theoretical strength (σ_{Th}). It is clear from the Eqn. (5) that with an increase in the $\frac{\delta}{\lambda}$ ratio, there is always decrease in the theoretical strength of the material. Thus, the characteristics of different materials are shown in Fig. 2. Except NaCl, all the materials in Fig. 2 are used in the glass industry and their comparison with the data of fused silica makes sense in understanding the overall mechanical behavior of commercial glasses. It is clear that the different materials of the same $\frac{\delta}{\lambda}$ ratio have different value of theoretical strength. The theoretical strength of magnesia (MgO) is at the highest level and its value is 64.23 GPa. The next material is alumina (Al_2O_3), then glass, fused silica and sodium chloride (NaCl) respectively. The material having the lowest theoretical strength is sodium chloride (NaCl) whose theoretical strength value is 18.36 GPa.

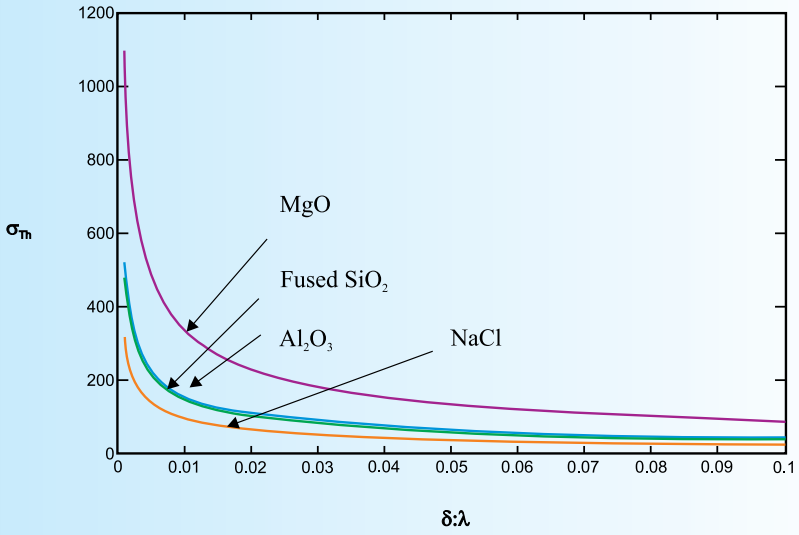

Fig. 2: Theoretical strength vs. fluctuation for different materials

Conclusion

The modification of the basic equation on theoretical strength has been achieved, within the context of a sinusoidal approximation in the applied stress vs. spatial elongation curve [3], by assuming a small spatial variation and by changing the limit of integration in the energy formulation for crack formation. This modification yields a ratio of this variation giving rise to a multiplication factor, which can correctly predict the theoretical strength

of brittle ceramic materials. The available data on fused silica has been fitted with this new model and found to be effective in explaining a lower observed strength due to the presence of micro-flaws. Many such data on other brittle ceramic materials can be fitted in future to give it a comprehensive shape.

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Beacons of hope for photovoltaics

Drastic cuts to subsidies in many European countries are forcing the solar industry to implement immediate cost reductions. This has resulted in a greater focus on multi-crystalline silicon cells again, a technology that delivers value for money and an efficiency that can be increased with relatively little effort. Sebastian Pflügge and Brigitte Küppers report.

Technology should no longer be an issue. When there was growing demand for photovoltaic systems in the 1990s, solar cells made from multi-crystalline silicon were already regarded as obsolete. These cells were too bulky and their average efficiency of a mere 10% was inadequate. Soon therefore, they were replaced by thinner and more powerful absorbers.

In the 1990s, the US government invested over a billion dollars in the development of thin-film cells and multiple cells. While thin-film cells aroused considerable interest in research due to their reduced material requirements, multiple cells fascinated researchers with their high level of efficiency. Under this technology, nearly 40% of light is converted to electricity, involving the use of up to five different layers of semi-conductors.

At the same time, in Japan, research concentrated on pure mono-crystalline silicon. Take, for example, so-called heterojunction cells (HIT); to avoid loss of charge carriers, they are additionally surrounded by a further protective layer of amorphous thin-film silicon and achieve efficiency levels of over 20%. In Germany, on the other hand, companies continued to work with multi-crystalline silicon despite reservations. "Industry in this country invested not so much in revolutionary cell technologies but more in the evolution of existing methods" says Eicke Weber, head of the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg. With hindsight, it has since then become obvious that this was intuitively the right way forward. Multi-crystalline cells are still dominating photovoltaics, according to market researcher Navigant Consulting, with a 47% market share that is clearly ahead of mono-crystalline cells (38%). These are followed at quite some distance by thin-film cells, with a share of 14%, while multiple cells do not figure in market statistics at all.

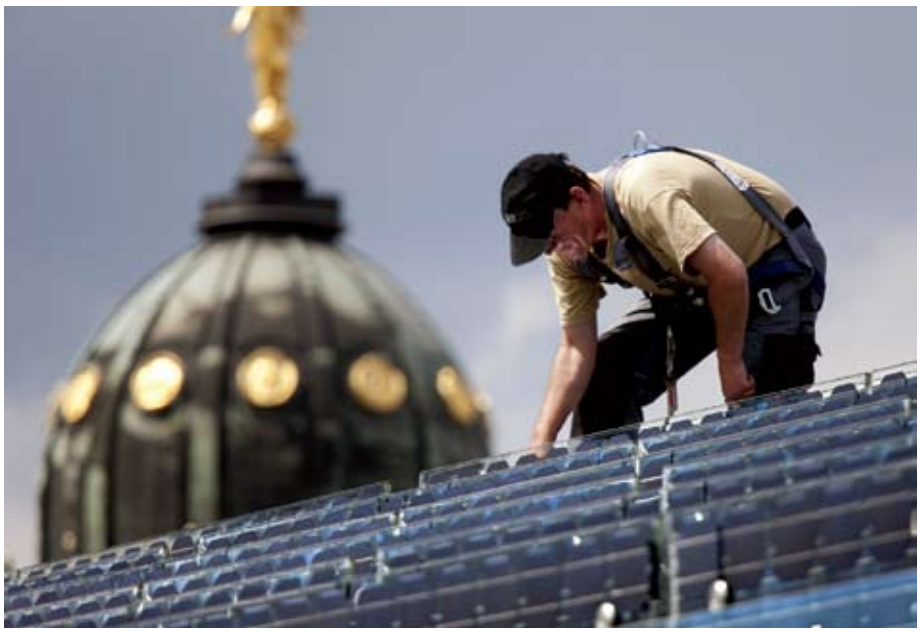
UNDERESTIMATED TECHNOLOGY

So far, however, there has been no way round multi-cells. The reason is quite simply that innovations tend to arise much faster here than in any competing technologies. "Over the last 10 years, average efficiency has gone up from 10% to 15%" the ISE's Eicke Weber confirms. At the same time, material requirements have gone down. In fact, silicon wafers are 0.2mm in thickness, which is about a third less than 10 years ago. Also, standard multi-crystalline cells are easier to make than the latest products. This means that manufacturing lines can be set up quickly and the effects of scale can be achieved through greater production volumes.

It is only through so-called texturising that the silicon wafers receive their characteristic blue colour (Solarworld).

Thanks to improved and increasingly bigger volumes, costs have gone down dramatically. In February 2011, the online platform pvXchange published wholesale prices of about €1.70 per watt for crystalline modules made in Germany. Since then, manufacturers have reduced their prices by about a third, to €1.10 per watt. And this technology is set to become even cheaper. "I am confident" says Eicke Weber "that the efficiency of multi-crystalline modules can be increased to 20%." Any rise in efficiency automatically leads to a drop in material requirements and costs.

Considerable innovation potential can undoubtedly also be observed in thin-film and multiple cells, although technical progress is slower in this area. For example, thin-film cells



Crystalline silicon cells are leading the way in Germany's photovoltaics. A solar power plant is being installed on the roof of the Germany Ministry of Justice (Justizministerium/Paul Langrock).

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based on semi-conductors – ie copper, indium and gallium (CIS) – reached 13% but failed to undercut their crystalline competitors and CIS modules are still €1.50 per watt, according to pvXchange. "Developing larger production capacities for CIS is more difficult than expected" admits thin-film expert Michael Powalla from the Centre for Solar Energy and Hydrogen Research in Baden-Württemberg. Even multiple cell production lacks economic efficiency, due to its low level of automation.

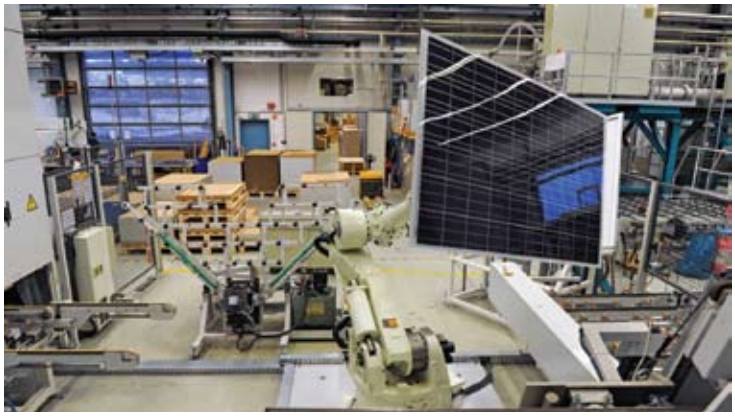
The problem is that the solar industry is running out of time to be competitive with photovoltaics. Nearly everywhere in Europe, countries with feed-in tariffs for solar power have radically cut those tariffs because the increase in solar installations was getting out of control. In Germany, for example, the solar power feed-in tariff is set to be reduced by up to 40%, according to the latest plans of the German government. "Anyone wanting to survive in this difficult market will need to cut their prices even more radically" says analyst Mathias Fawer from the Swiss bank Sarasin.

NO TIME FOR EXPERIMENTS

Today, multi-crystalline cells are the most appropriate technology for their purpose because they display the steepest learning curve. Germany's solar equipment manufacturers are the technology leaders in multi-crystalline technology and are aware of the decisive elements that are required for further innovations. Companies such as Bürkle, Centrotherm and Grenzebach provide equipment for all areas of the crystalline value chain, from silicon production to the manufacture of modules. Their machinery and automation solutions ensure fast gains in efficiency and reductions in production costs.

From 23 to 26 October 2012, at solarpeq, the international trade fair for solar production equipment and the parallel glasstec event, manufacturers will have opportunities to learn about their suppliers' innovative products and about cost reductions which they might achieve through them. Moreover, at glasstec, numerous exhibitors will present solutions for the use of solar end products in building envelopes.

One promising technology which is currently moving into many factories is multi-crystalline cells with passivated emitter and rear contact (or PERC cells, for short). In today's commonly available standard cells, electrons migrate towards the negative terminal at the front and electron holes migrate towards the positive terminal at the rear. The electric current flows off via an aluminium contact, which covers a large part of the wafer. Although the aluminium ensures good contact with the positive terminal, direct contact between the metal and the semi-conductor means that negative and positive charge carriers cancel each other out on this border; they 'recombine', as it were. Developers therefore use a simple trick: They replace the aluminium with a coat that reduces any loss of current; a so-called dielectric passivation layer, which may consist of silicon nitride, silicon oxide or aluminium oxide. However, the disadvantage of such coats is that they are non-conductive and therefore need to be open in several places in order to take through the metal power connectors and combine them with the semi-conductor.



Automation can lead to a clear reduction in manufacturing costs. Therefore, photovoltaics manufacturers use state-of-the-art equipment (image: Solarworld).

There is no other country where multi-crystalline cells have been researched as thoroughly as in Germany (image: Fraunhofer/Thomas Ernsting).

MULTI-LAYER DEVELOPMENTS

Thanks to Perc, Schott Solar, for example, has reached a module efficiency of 18%. However, the company wants to go one step further and make these cells from so-called quasi-mono silicon in the future. This semi-conductor, which is a multi-crystalline silicon, is regarded as a springboard into competitiveness within the industry. Like simple multi-crystalline material, it is made in crucibles, although it has the properties of the mono-crystalline material, which is of a higher quality. "We're hoping to boost efficiency by up to 2%, while keeping production costs at the same level" comments Schott Solar's Head of Development, Klaus Wangemann.

Normally, silicon is melted in a special crucible and is subsequently cooled down in a controlled manner. With ingot casting for multi-crystalline blocks, the crystals align themselves in different directions. So-called grain boundaries form in the spaces between them, ie the kind of irregularities that reduce the electric power output. Schott therefore, wants to insert a plate of mono-crystalline silicon at the bottom of the crucible, as seed crystals. When the semi-conductor cools down, it solidifies on this crystal and largely adopts its alignment. This avoids efficiency-reducing defects in the material. Schott is hoping to use its quasi-mono material in cells for the first time in 2013.

Finally, with decreasing costs of material and production, a technology is now attracting attention among manufacturers that has so far been avoided, as production was relatively difficult; so-called metal-wrap-through (MWT) cells. Under this method, which was developed by the Dutch energy researcher ECN, the busbars are led through internally, at the rear. As a result, there are not as many conductor paths on the front that might keep the light from the cells. This leads to an increase in efficiency and makes it possible to use better production methods for the modules.

As many as five companies – Schott Solar, Bosch Solar, Ja Solar, Kyocera and Canadian Solar – now want to mass-produce this equipment, understandably so, as it allows modules with an efficiency level of up to 16%. It means that multi-crystalline technology is moving into an efficiency range that has so far been reserved for more expensive mono-crystalline modules. ■

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GLASS – INDISPENSABLE BUILDING MATERIAL

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In old days, use of glass in construction considered fragile and had very limited applications, mostly in window and ventilator panels. During last few years, glass became a favored feature in buildings and is used extensively in both exterior and interior applications. The skylines of Metros are dotted with high-rise buildings clad in glimmering glass, boasting affluence & style. Popularity gained not because of fashion, competition or fascination of architects, designers, specifiers and consultants but due to inherited properties, unmatched quality and advantages glass has which may be spelled out as freedom from conventional building shapes, adds beauty and aesthetics to the building, does not deteriorate, corrode, stain or fade, pure and sustainable material, transparent to visible light, optimal use of day light, satisfies sense of openness and harmony, helps to maintain clean environment because of zero degeneration, can be recycled indefinitely, helps to maintain hygienic environment with easy maintenance, saves the space inside the building, no extra design is required for floor/roof slab for making glass partition on upper floors being lighter in weight, as cladding fulfill functional requirement of lighting, heat retention and energy saving, excellent material for thermal insulation, water proofing and energy conservation, as bad conductor of heat saves energy in air conditioning of building etc.

However, glass being fragile in nature, needs care while selecting thickness, type and size and adequate consideration for imposed loads, supporting structure, human safety and installation etc. Another, contentious issue is that of energy efficiency, which can be addressed by selecting proper and value added glass, controlling solar radiation and UV light, shading, implementing Energy Conservation Building Code (ECBC) etc.

Today glass is utilized in the construction of several elements of exterior and interior architecture. Exterior glass architecture includes facades, display windows' skylights, skywalks, entrances, revolving doors, canopies, winter gardens and conservatories. Attraction is homes are bathed in natural sunlight with gorgeous outdoor views. Interior glass architecture can be used for doors, partitions, shelves, staircases, elevated walkways and even as traditional walls. There are some houses in which all of the walls are actually glass. Selecting glass can be a challenge and the decision for right type of glass for different applications, in terms of type of building, uses, requirement, performance, quality, eminence etc is very crucial. Different types of glass available are jotted down below.

1. Flat Glass: This is the basic glass that was available for use before the discovery of the float process. It is no longer in use for most architectural use, but is used in glass art to create sculptures and decorative items.
2. Float Glass: Float glass or annealed glass is a term for perfectly flat, clear glass manufactured by the float process invented in the UK by Sir Alastair Pilkington in 1959. It is the most basic type of glass and forms the basis for several fabricated glasses that are used in construction.
3. Tinted Glass: Colorants are added to the normal clear float during manufacture in order to achieve tinting and solar-radiation absorption properties. The color is achieved upon the addition of a mineral admixture. Tinting reduces heat penetration in buildings.

   Application: Using tinted glass is the simplest form of introducing an element of solar control to a building. In terms of its ability to reduce the heat intake, tinted glass is better than clear float glass, but is exceeded in terms of performance by reflective and laminated glass. In interiors, tinted glass can be used for partitions, furniture, table tops and doors. Because of its solar properties and aesthetic appeal, it is common choice

for the atria in commercial buildings.

4. Reflective Glass: Glass that is coated to reflect radiation striking the surface of the glass, thereby reducing solar heat gain, is called reflective glass.

   Applications: The major application for reflective glass is on the exteriors, for facade glazing in commercial, educational, industrial and residential buildings. In interiors, it is used for effects only.

5. Low-e Glass: Low-e glasses are innovative coated glass that has the unique ability of preventing heat loss in cold weather while reducing heat intake in warm weather.

   Applications: It is popular in residential, commercial and industrial applications where thermal control is a priority.

6. Toughened Glass: Toughened or tempered glass is produced when float glass panels are heated and then cooled rapidly in a controlled environment. This process makes the glass several times stronger than regular glass. It also makes it safer because when broken it yields small pebble-like fragments.

   Application: Toughened glass is used wherever strength is required and regular annealed glass will not be sufficient, like in high traffic uses like entrances, in conditions where high wind loads need to be taken by the glass surface, etc. Glass facades, sliding doors, building entrances and bath and shower enclosures are the most common uses. Fire knock-out panels, fireplace enclosures and kitchen objects like vegetable chopping board and cooking pot lids are other uses.

7. High Strengthened (HS) Glass: This is a particularly heat treated glass that is popular for vertical spandrel applications and as the base material for lamination.

   Application: Its mechanical strength is twice that of annealed glass and half of fully tempered glass, and it retains all the properties of annealed glass-chemical resistance, hardness, expansion, and deflection.

8. Heat-Soaked Toughened Glass: This is simply fully tempered glass that has been processed to eliminate nickel sulfide inclusion that can cause spontaneous breakage. Heat soaked glass has shown 98.5% reliability in tests.

9. Laminated Glass: Simply put, this is glass which is composed of two sheets of glass permanently bonded together with a sheet of transparent plastic between the sheets. The plastic is known as interlayer and different inter layers can impart different properties.

   Application: Laminated glass is used as safety glazing in public buildings, commercial and retail structures in overhead usage, and large facades. It also serves as security glazing in residences, embassies, banks, and combat vehicles and sound control in offices, institutions, malls, residences, airport, bus terminals, and recording studios. Other applications include skylights, aquariums, entrance doors and glass floors.

   Safety: Laminated glass does not shatter like ordinary glass and has ability to absorb impact and resist penetration. It does not shatter and remains intact when broken, holding glass fragments in place. It is the correct glass to use for overhead applications.

   Security: This same property is useful for security, and burglar intrusion is minimized using laminated glass. The interlayer continues to be in place even if the glass is broken, increasing security. Ordinary glass cutters and break-in tools are not effective on laminated glass as it needs to be cut in from both the sides. Infect, laminated glass is the only glass to provide post-breakage strength. It is necessary to use multiple glass sheets and inter layers if laminated glass is to be used into resist bullets, blasts and explosions. Alarm Glass is a particular form of laminated glass that is used for security purposes. The glass has 0.1mm wires embedded in the interlayer. The wires form an electrical circuit which, if broken in the event of the glass sheet being smashed, sets off an alarm. An alarm glass is formed when an interlayer is embedded with a very thin wire and then "sandwiched" between two or more sheets of glass.

   Bullet-resistant glass is a transparent material or multiple layers of laminated glass that provides the light transmittance of normal glass but varying degrees of protection from firearms. A type of bullet-resistant glass is formed when a polycarbonate layer, usually consisting of products such as Cyrolon, Lexan and Tuffak, is sandwiched between layers of regular glass. A bullet can pierce the exterior glass layer, butttrong polycarbonate layer before it can pierce the inner layer of glass. This type of bullet resistant is

usually 70-75mm thick.

Disaster resistance: Many special inter layers have been developed to help the glass withstand earthquakes, high wind speed and other disasters.

Sound Control: Use of inter layers can considerably reduce entry of noise. The visco-elastic properties of interlayer have a dampening effect on noise.

Solar Energy: When used with tinted glass, laminated glass is effective in reducing solar heat gain and ultra-violet rays. In warm climates, when laminated glass is used to combine with reflective coated glass or low-e glass, it can give good shading and energy savings as well as increase comfort level. Since UV rays cause deterioration and fading of fabrics, picture and furnishings, laminated glass will give interiors a longer life as well. UV control inter layers screen up to 99 per cent of UV rays.

Durability: Inter layers lend durability to the glass. It is also easy to clean, like ordinary glass.

Fire-resistance: Standard laminated glass does not meet code requirements for fire-resistant glass. However, since it does not disintegrate easily when exposed to heat, it will provide more time for evacuation and fire control.

10. Insulating Glass (IG Units): This is a double glass unit used instead of single glazing.

    Application: They are commonly used in offices and institutions. Often, insulating glass is used on the surface that takes the maximum direct sunlight. Insulated glass is mandated in many countries for residential buildings in order to save on heating costs in the cold weather.

    Multiple Glass Combinations: Following the same principle as insulating glass using two surfaces, it is possible to construct an insulating unit using several glasses. These are used in special application where high levels of insulation are required.

11. Wired Glass: This is a flat rolled glass reinforced with wire mesh and used especially for glass doors and roofing to prevent objects from smashing through the glass and also to hold pieces of broken glass together. In general, it is going out of use as better options are available now. Also, there have been controversial incidents where people have sustained injuries because of wired glass.

    Applications: Exteriors and interiors of general construction. Doors and windows of buildings where fire protection and locations where fallout protection is required.

12. Mirrors: A mirror is a type of glass that has a highly reflective surface and is used for seeing reflections.

    Different types of Mirrors: Mirrors can be vacuum coated, UV coated or copper free. In a vacuum coated mirror, a metal film is coated on the glass in high vacuum chamber to ensure film purity and better adhesion. This type of mirror has a longer life and the coating is more durable. In a UV coated mirror, a UV treated polymer is coated over the paint coat. The polymer coat is applied by a roller and this coating provides better scratch resistance, removes black spot problems, and reduces the effect of moisture. In a copper-free mirror, a coating of palladium is used instead of copper, which eliminates black spots and is environmentally friendly.

    Application: Mirror have been used for centuries, specially hand mirrors, and have a wide range of applications. In architecture, it is mostly used for decorative purposes, in furniture, panels, doors, etc. as well as to create spatial effects.

13. Antique Mirror: It is a decorative silvered glass mostly used for interiors.

    Application: Has decorative properties and is used in homes, hotels and restaurants, in museums, etc.

14. Stained Glass: Stained glass refers to glass that has either been painted and fired or colored by adding metallic salts during its manufacture and often both. Metals such as copper or gold are used to bring in colors like blue, green, oranges, red, etc.

    Application: Widely used in churches and mosques. Used extensively for decorative purpose in furniture, panels, lampshades, windows, doors, partitions.

15. Sandblasted Glass: Sandblasted glass is one that has a design or form done on it by spraying sand. This texture is rougher than the rest of the glass and its translucent.

    Application: Sandblasting can be used in residential or commercial establishments. It is often used as partitions, shower curtains, interiors screens, on furniture, etc.

16. Etched or Patterned Glass: This is a form

of decorative glass obtained by etching one side. It is visually appealing. An industrially produced glass ensures uniformity of coating and will not show patching.

Application: Acid-etched glass is used extensively as partitions, shower curtains, paneling, furniture, doors, etc.

17. Lacquered Glass: This is another kind of decorative glass meant for interiors use.

    Application: Bathrooms and kitchens are the most common application required with low maintenance finishes.

18. Screen-printed Glass: Screen-printed or enameled glass is one that is tempered or heat-strengthened glass, one face of which is covered, either partially or totally, with mineral pigments.

    Application: Used for glazing, cladding in facades and roofs. Its malleability makes it useful for a variety of applications.

19. Fire Resistant Glass: Fire resistant glass is a special laminated glass that has properties to protect from heat and fire. When exposed to fire, the pane facing the flames fractures but remains in place and as the heat penetrates the glass, the interlayer begin to foam and form a thick insulating shields that blocks the fire.

    Application: In the interior fire resistant glass is used in windows, doors, walls and partitions. Facades and sloped glazing applications are some exterior uses.

20. Bent Glass: It is a normal glass that has been curved with a special process to give it a different look.

    Application: it has uses in external as well as internal spaces. It can be used for facades, shop fronts, panoramic lifts or showcases, shower doors, refrigerator cabinets, etc.

21. Extra Clear Glass: It is pure and absolutely clear glass.

    Application: It is used for windows while displaying expensive or rare objects, like crystal, jewelry, watches, art, etc. It is also used in scientific applications, like photovoltaic modules.

22. Photovoltaic Glass: Photovoltaic glass is special glass with integrated solar cells, to convert solar energy into electricity. This means that the power for an entire building can be produced within the roof and facade areas.

    Application: It is used on facades and roofs, where maximum amount of solar energy can be collected.

23. Electro-Chromic Glass: This is an effective electricity saving component for buildings. The glass changes according to the harshness of sunlight.

    Application: It can be used in facades and windows in office buildings and malls.

24. Self Cleaning Glass: It is an ordinary float glass with a special photo-catalytic coating.

    This type of glass has a natural cleaning property. The active integrated coating on the outside of the glass absorbs the sun's ultraviolet rays. This causes a reaction on the surface which breaks down dirt and loosens it from the glass. It also has hydraulic properties. When it rains or water is poured over it, it washes the dust off the glass, instead off leaving it on the glass like other glasses.

25. Anti Reflective Glass: It is a normal float glass, but with a special coating that allows very little reflection of light. This type of glass has maximum transparency and lowest light reflection rates. It allows optimum viewing through the glass at all times.

    Application: Has wide range of applications in exterior as well as interiors including windows, walls, partitions, panoramic restaurants, air traffic control towers, petrol station windows, high quality picture framing, display cabinets and interior display windows, dividing screens in cinema projection rooms, television studios, machine control rooms, etc.

Design considerations and parameters influencing selection of suitable, appropriate and right type of glass and its application should be decided taking into account heat gain, sound insulation, thermal breakage, human impact, security, fire, wind load, allowable span, installation, and thickness etc. Various codes and references are available for meeting the above requirements. But human safety due to impact, fire, natural and manmade disaster is a very important aspect which needs utmost attention. Authorities react and show serious concern only when such untoward incidences occur but dilute the priority instead of taking immediate adequate measures to prevent losses in future. Recently blaze at Commercial Complex in the Bandra-Kurla Complex in Mumbai on 7th September 2012, at Amri Hospital at Dhakuria in Kolkota, at Diamond Square at Kalina in Mumbai on 8th April 20111 and at many similar instances, firemen faced problem to access in the building,

undertake rescue operation and fire fighting due to fixed glass façade which again forced authorities to think seriously for enactment of safety norms and incorporation in building byelaws.

In India no guidelines, standards/byelaws governing use of glass in buildings existed till 2007. In fact even the National Building Code 2005 which serves as a Model Code for adoption by most departments and agencies involved in building construction is completely silent on this issue. Even major construction departments in the country do not have any documented or specified guidelines to refer to enable them to follow or include in their specifications architectural drawings, tender documents etc to ensure safe use of glass in buildings. Prevailing Building Bye Laws adopted by the local bodies absolutely do not have any mention or reference of glass in their documents to ensure human safety or combat calamities like fire etc. Construction/building plans are sanctioned by the local bodies without taking into consideration of human safety aspects and precautionary measures required to be taken care while using glass in buildings.

Considering the utmost importance of this issue, Confederation of Construction Products and Services (CCPS) - a nonprofit organization has brought out the "Guidelines on Use of Glass in Buildings - Human Safety" in November 2007 through PPP mode using consensus method involving experts from Central & State Govt. Departments. The recommendations of the Guidelines are based on test standards as outlined by Bureau of Indian Standards (BIS) and conform to the IS 2553 (Part 1): 1990 – Safety Glass – Specification, General Purpose and suggest how to regulate glass in relation to human safety by either, restricting use of glass or specifying use of Safety Glass at critical locations where chances of injury due to glass breakage are high. Consideration for manifestation, fire fighting and smoke exhaust is also included and recommend in case of external laminated glass facades, openable portions have to be left at regular distances as required for fire fighting and smoke exhaustt.

Recognizing the importance of the subject and increased use of glass, Andhra Pradesh was the first state to initiate action to ensure human safety by issuing G.O.Ms. No. 205 on 27.02.2009 to all authorities in the State to follow and ensure the guidelines and conditions whenever permissions are accorded for usage of glass in buildings. Following the GO, Greater Hyderabad Municipal Corporation (GHMC) has also issued Circular No. Glass/TPS/HO/GHMC/2009 dated 10.11.2009 to indicate as one of the condition on usage of glass in the plans while releasing the building permission. Now the responsibility lies with the authorities and departments of Andhra Pradesh to strictly follow the GO and Building owners, developers, builders, licensed Engineers, Registered Architects should be made accountable and authorities should insist for a joint certificate to the effect that the uses of glass in building is done properly according to and as specified in the CCPS Guidelines.

This was a motivating, inspiring and encouraging effort to be followed by other States and departments. Till date total 13 States, Central & state Govt. departments and PSUs which include Govt. of Andhra Pradesh, Govt. of Rajasthan, GHMC, Central PWD, NBCC, Airport Authority of India, Govt. of Delhi PWD, Haryana PWD (B&R), Delhi Development Authority, Rajasthan Housing Board, Town Planning Deptt, Govt. of Rajasthan, Govt. of Manipur PWD and Andaman PWD mandated the Guidelines. Some of the orders issued in this regard are on next pages.

CCPS has always been showing its commitment to propagate safe use of glass in buildings to ensure human safety in public interest and offer to provide all sorts of information and organize capacity building workshops to highlight and acquaint engineers, architects, consultants, builders, planners, fire fighters, government officials etc about the salient features of the guidelines. Now its time to join hands to include the recommendations of the CCPS Guidelines in Buildings Byelaws of all municipal bodies and development authorities to ensure human safety while using glass in buildings without waiting until a number of people lost their lives sacrificed their limbs or accidents to occur.

[References: Guidelines on use of glass in buildings-Human Safety (CCPS), Construction Products in India (CCPS), Guidelines for Use of Glass in Buildings (Dr. N.K. Garg), Article in Kanch, Apr-June 2012 issue by Shashi Kant]

Government Order/Circular issued in Andhra Pradesh to ensure use of Safe Glass

GOVERNMENT OF ANDHRA PRADESH
ABSTRACT

Support on ensuring safe use of glass in buildings through appropriate Building bye-laws – Guidelines – Issued

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MUNICIPAL ADMINISTRATION & URBAN DEVELOPMENT (M1) DEPARTMENT

G.O.Ms. No. 205 Dated 27.02.2009
Read the following:

1. From the representation of Convener, Confederation of Construction Products & Services (CCPS), New Delhi Dated 07.04.2008 & 07.08.2008
2. From The DTCP, Lr. Roc. No. 7049/2008/A, Dt: 21.08.2008.
3. From G H M C, Lr. No. 2378/HNC/TPS/G H M C/2008, Dated: 31.12.2008.

* * *

ORDER:

In the modern lifestyle, increased glass use in buildings offers many advantages; those who spend more time indoors have intuitively understood benefits of improved daylight and vision on human psychology and health. Recent research findings underscore these indisputably. However, this increased use of glass in Indian buildings is not without risks. Wrong selection of glass type is widespread and does result in increased heat gain/loss in buildings and the higher risk of injuries to humans. Further, safety glazing (glass) is required by the International Residential Code (IRC) in a number of locations and is intended to reduce the potential for injury in the event of accidental impact with the glass. The placement of safety glass is in areas that are more likely for people to fall into on or through. Examples include glass in or near to doorways, bathtubs, sliding doors, and near the floor.

2. The two most common types of safety glazing are tempered and laminated. Tempered is the most common type of safety glass used in residential applications because it far less expensive than laminated glass. It has a higher tolerance to impact without breaking. Further, when tempered glass does break, the entire pane of glass crumbles into large granules that resemble large pieces of rock salt. Crumbled glass is less likely to cause serious injury than the shards that result from broken annealed glass. The safety glazing is required, where people are at risk from colliding with glass windows etc, where the glass should be robust enough not to break or be constructed of safety glass, or have suitable guarding. Large sheets of glazing needs to be made obvious so that people do not collide with it.

3. The Confederation of Construction Products and Services (CCPS), in their representation 1st read above have represented that which is a non profit organization took the lead and has prepared the "Guidelines on use of Glass in Buildings part A: Human Safety". The Government organizations like CPWD, NBCC were also involved in the consensus process while preparation of the guidelines. The CCPS has therefore requested this department to issue instructions to the concerned authorities in the public interest and to help in minimizing glass usage and to avoid human risk and ensure safety while using glass in the buildings and to take necessary steps to include the guidelines in the NBCC for better adoption.

Contd...2..

4. The DTCP, Hyderabad and the Commissioner & Special Officer, Greater Hyderabad Municipal Corporation, Hyderabad in their proposals 2nd & 3rd read above have supported the proposals and requested the Government to put certain conditions and issue guidelines on usage of glass in buildings and to ensure human safety.

Government after careful examination of the matter and taking into consideration of the recommendations made by the Confederation of Construction Products & Services (CCPS), New Delhi and the proposals submitted by the DTCP, Hyderabad and Commissioner & Special Officer, Greater Hyderabad Municipal Corporation, Hyderabad and also in order to ensure Human Safety and public interest and to minimize the usage of glass and to avoid human risk and ensure safety while using glass in the buildings, hereby issue guidelines and conditions on usage of glass in buildings particularly in commercial complexes, multiplex and multistoried buildings as follows:

1. Safety glazing material shall be used where
   a) Any glazing is within 1.5. metre above the floor level of building,
   b) There is danger of falling infill glass materials from overhead glazing and
   c) There is danger of galling due to change in floor level in case of balustrades, stairs and floors.
2. Necessary precautions should be taken to enhance a person's awareness of the presence of glass by making glass visible and to minimize manual handling of large pieces of glass during installation.
3. Any glass with still height > 0.75m or with Residual Protection type of glass shall be used as vertical walls.
4. Safety glass of no risk of fall (Falling height < 1.5m) and still height<0.75m shall be used as vertical walls.
5. Safety glass of risk of fall (Falling height > 1.5m) and still height<0.75m shall be used as vertical walls.
6. Laminated Safety glass shall be used in Horizontal or sloped glazing and as a balustrade, parapet or a railing.
7. Toughened(Tempered) Glass or Laminated Safety Glass, subject to meeting the Definitions and Test standards as outlined in the IS 2553 (part I) and the Guidelines on use of Glass in Buildings
8. Part A: Human Safety" prepared by CCPS, shall be used in the building.
9. Windows, skylights and ventilators over two meters high, shall have controls, limiters and safe access for cleaning on both sides.

Contd..3..:

10. In case of external laminated glass facades, open able portions shall be left at regular distances as required for fire fighting and smoke exhaust
11. Laminated glass with both glass panes toughened will not classify as safety glass.
12. Clear glass panels capable of being mistaken for an unimpeded path of travel shall be marked to make them visible by incorporating manifestation as mentioned in the CCPS guidelines.
13. All Safety Glass should be ISI marked along with the name or logo to identify the manufacturer of the safety glass.

6. All the Commissioners of Municipalities / Corporations and Urban Development Authorities and Metropolitan Commissioner, Hyderabad Metropolitan Development Authority, Hyderabad are requested to follow and ensure the above guidelines and conditions whenever permissions are accorded for usage of glass in buildings particularly commercial complexes, multiplex and multistoried buildings and ensure the quality of Glass with the stand set complies in the standards as required by the International Residential Code (IRC) and to make the building owner and the Engineer/Architect shall be responsible for ensuring the use of glass complies with the stands and to insist for a joint certification of the building owner and the licensed Engineer/ Registered Architect to the effect that the usage of Glass in the Building is done properly according to the standards of the International Residential Code (IRC) and Guidelines on use of Glass in Buildings and as specified in the guidelines and code of practice issued by Government of India or other agencies from time to time.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

Dr C.V.S.K. SARMA,
PRINCIPAL SECRETARY TO GOVERNMENT

To
All the Municipal Commissioners in the State (through C&DMA, A.P. Hyderabad).
The Commissioner & Director of Municipal Administration, A.P. Hyderabad.
The Commissioner & Special Officer, Greater Hyderabad Municipal Corporation, Hyderabad.
The Metropolitan Commissioner, Hyderabad Metropolitan Development Authority, Hyderabad.
The All Vice Chairmen's of Urban Development Authorities in the State.
The All Commissioners of Municipal Corporations in the State.
The Director of Town & Country Planning, Hyderabad.
Copy to:
The Convener, Confederation of Construction Products & Services (CCPS), New Delhi.
The PS to Special Secretary to CM / M (MA)/ Prl. Secretary / Secretary (MA&UD) Sf/Sc.

// FORWARDED :: BY ORDER //

SECTION OFFICER

{www.ap.gov.in-> -Govt. orders- >Select Deptt.: -Municiple Administration & UD- > Select Section : -M- >Search- > Select GO NO. 205 dated 27.02.09, (Sequence ID 59554)}

GREATER HYDERABAD MUNICIPAL CORPORATION

Office of the Chief City Planner,
Town Planning Section
Hyderabad.

CIRCULAR

No.Glass/TPS/HO/GHMC/2009 Date : 10.11.2009

Sub : GHMC – T.P.Section – Support on ensuring safe use of glass in building through appropriate Building Bye-laws – Guidelines – Reg.

Ref: G.O.Ms.No.205 MA, dt:27.02.2009

***

In G.O.Ms.No.205 MA, dt:27.02.2009, Government have issued guidelines and conditions on usage of glass in buildings particularly in commercial complexes, multiplex and multistoried buildings (copy enclosed).

Therefore, same shall be indicated as one of the condition in the plans while releasing the building permission.

for Chief City Planner,
G.H.M.C.

Copy to :
All Addl. CCPs / CPs / ACPs of H.O.
All TPAs of H.O.
All T.P.Staff.

Copy to
Sri Shashikant, Advisor, confederation of Construction Products and services. (CCPs), New Delhi with reference to letter dt:13.8.09

Office Memorandum issued by Central PWD and NBCC to follow Guidelines in their Departments throughout the Country

Govt. of India
(Technology Application and Standards Unit)
Central Public Works Department
Nirman Bhawan, New Delhi

No: 129/SE(TAS)/2007/212 Dated: 04-08-2009

Office Memorandum

CPWD has developed "Guidelines on use of glass in buildings- Human safety" through Public Private Partnership with Confederation of Construction Products and Services (CCPS). These guidelines are developed through consensus approach involving all stake holders, various PWDs and other Govt. departments etc.

The use of glass in buildings has increased manifolds. The worldwide increase in use of glass has become a matter of concern from human safety point of view.

Recognizing the gravity of the problem and uncertainty faced by the Engineers, Architects and users, the guidelines for selection of appropriate safety glass suitable for a particular location have been brought out.

CPWD has already issued instructions vide O.M. no. 109/SE(S&S)/EE-III/Tech. Misc./26 dated 18/2/2008 to all the officers in the department to promote awareness about Human Safety while finalizing specifications for glazing. The purpose of guidelines is not to sell more safety glass but to exhibit the wide choice that exists and allow the use of glass with precautions in order to reduce the risk of accident.

It should be ensured that henceforth, these guidelines shall be followed in the department to ensure safe use of glass while planning, designing and executing the buildings.

This issues with the approval of DG(W).

Encl: As above

(PRITPAL SINGH)
Executive Engineer (S&S)-III

To

1) All ADGs, CPWD/Engineer-in-Chief (PWD), GNCTD.
2) All Chief Engineer (Civil/Elect, CPWD/PWD, GNCTD.
3) All Superintending Engineer(Civil)/(Elect.), CPWD/PWD, GNCTD
4) All Executive Engineer(Civil)/(Elect), CPWD/PWD, GNCTD

Copy to:

1) Member (HUD), Planning Commission with reference to OM No. 20/1/2007-Tpt dated 6/1/2009.
2) Secretary, Ministry of Urban Development, Nirman Bhawan, New Delhi.
3) Secretary, Ministry of Housing & Poverty Alleviation, Nirman Bhawan, New Delhi.
4) Adviser (HUD), Planning Commission, Yojana Bhawan, New Delhi.
5) PPS to DG (W), CPWD, New Delhi.
6) CCPS, G-4, Raj Tower, Alaknanda Shopping Complex, New Delhi- 110019

Executive Engineer (S&S)-III

NBCC — नेशनल बिल्डिंग्स कन्स्ट्रक्शन कार्पोरेशन लिमिटेड — NATIONAL BUILDINGS CONSTRUCTION CORPORATION LIMITED (A Government of India Enterprise) — An ISO 9001 Company

Safety Management Cell.
Corporate Office,
NBCC Bhavan, Lodi Road,
New Delhi-110003..
Dated, 25th January, 2012.

No. AGM / Safety /2011-12 /31

To,
All Executive Directors,
H- RBG's, H-SBG's,
HoD's at Corporate Office ,
NBCC Ltd

Subject: Guidelines on use of Glass in Buildings Human Safety.

Dear Sir,

The use of glass in buildings has increased manifolds. The worldwide increase in use of glass has become a matter of concern from human safety point of view.

Recognizing the gravity of the problem and uncertainty faced by the Engineers, Architects and users, "Guidelines on Use of Glass in Buildings- Human Safety "has been brought by Confederation of Construction Products and Services, New Delhi.

These guidelines suggest how to regulate use of glass or specifying use of Safety Glass at critical locations where injury due to glass breakage is high. As per the guidelines, following are the conditions on uses of glass in buildings.:

1. Safety Glazing material shall be used where
   a) any glazing is within 1.5 metre above the floor level of building
   b) there is danger of falling infill glass material from overhead glazing and
   c) there is danger of falling due to change in floor level
   d) in case of balustrades, stairs and floors.
2. Any type of glass in locations having Sill Height Hs ≥ 0.75 m or with Residual Protection shall be used as vertical walls.
3. Safety glass in locations having no risk of fall (Falling height Hfs≤1.5 m) and Sill Height Hs < 0.75 m shall be used as vertical walls.
4. Safety glass in locations having risk of fall(Falling height Hf≥ 1.5 m) and Sill Height Hs<0.75 m shall be used as vertical walls.
5. Laminated Safety Glass shall be used in horizontal or sloped glazing and as balustrade, parapet or a railing.

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NBCC HAS ZERO TOLERANCE FOR CORRUPTION!

CORPORATE OFFICE

NBCC — नेशनल बिल्डिंग्स कन्स्ट्रक्शन कार्पोरेशन लिमिटेड — NATIONAL BUILDINGS CONSTRUCTION CORPORATION LIMITED (A Government of India Enterprise) — An ISO 9001 Company

: 2 :

6. Toughened (Tempered) or Laminated safety Glass , subject to meeting the definitions and test standards as outlined in the IS : 2553 and the Guidelines on use of glass in buildings , prepared by CCPS shall be used in buildings.
7. In case of external laminated glass facades, openable portions shall be left at regular distances as required for fire fighting and smoke exhaust.
8. Clear glass panels capable of being mistaken for an unimpeded path of travel should be marked to make them visible by incorporating manifestation as mentioned in the CCPS guidelines.
9. However, if the smaller dimension of pane is 250 mm or less, and its area is 0.50 sqm or less, glass not conforming to safety requirements can also be used.

It is, therefore , enjoined upon all engineers, architects of NBCC to ensure that these guidelines are followed in its true letter and spirit , while planning, designing , executing, and approving buildings / projects to ensure safe use of glass.

A copy of the said guidelines is enclosed for your ready reference and perusal and wide publicity to all the zones, units, sites etc of NBCC under your administrative control and other stakeholders, and including the same as a part of technical specifications of NBCC tender documents.

This issues with the approval of Executive Director (PMG)

(N.P. Anand)
Addl. General Manager (Safety)

Encl:- Guidelines on use of Glass in Buildings- Human Safety-as stated.
Copy to :-
DGM to CMD for kind information of CMD pl
EO to Director (Projects) for kind information of Director (Projects) pl.
Sr EO to Director (Finance), for kind information of Director (Finance) pl.
EO to CVO for kind information of CVO pl.
Confederation of Construction Products & Services, S1 &S2, 3rd floor, Abhishek Tower D2, Alaknanda Commercial Complex, New Delhi- 110 019 - Kind Attn. Er. Shashikant, Adviser.

Addl. General Manager (Safety)

NBCC HAS ZERO TOLERANCE FOR CORRUPTION!

CORPORATE OFFICE

GLACERA ENGINEERS

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  - Furnace building, commissioning & maintenance
  - Selection & commissioning of combustion system, instrumentation & allied equipment
  - Selection of raw material
  - Designing of fully automatic batch house and cullet handling system.
  - Selection, installation and commissioning of production machinery and annealing lehrs
  - Installation and commissioning of quality control equipment and packing machinery
- **Furnace design, building, maintenance, modification and modernization**
- **Conversion of combustion system**
- **Furnace audits for reducing fuel consumption and predicting furnace life**
- **Energy efficiency improvement using mathematical models**

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Tel +91-20-26681146 ■ Mobile +91-93701 46890 ■ Email: glacera@gmail.com, prempmalhotra@gmail.com

Architectural applications

Glass stairs create maximum transparency in the stairwell. This multilevel construction was designed by Glas Trösch using the Swissstep system

Picture: Glas Trösch / Photo: Hans Ege Luzern

In interior design, glass is noticeably replacing typical interior materials such as wood and stone. This trend was made possible thanks to new refining technologies and the creativity of the glass refiners with regards to product development and marketing.

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Originally published in **glass machinery plants & accessories** 3/2012

Continuing the trend towards glass in interior zones

For façades, glass has long since gained status as preferred material. Refined into high-performance functional glass, the transparent material takes on various functions in the building shell. It offers protection from heat, sunlight and noise, directs light to specific areas in rooms, and – thanks to its unique transparency – facilitates light, open architectural design. In addition, glass also offers nearly unlimited design options. Glass can be transparent, translucent or opaque. It can create architectural accents through colour and individual designs and fulfil the toughest security requirements, at the same time. No other façade material offers a similar scope of design possibilities.

DRAWING INTEREST

While the advantages of glass in façade construction have been valued for decades, the glass trend in interior design only started in the last 10 years. Two framework conditions are mainly responsible for the extraordinarily positive development of the material in the area of

Picture: Glas Marte GmbH

Digital printing on glass and foils opens up nearly unlimited design possibilities. Room dividers, glass doors or shower walls can be printed with individual motifs in high resolution

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Continuing the trend towards glass in interior zones

Picture: ClimaplusSecurit-Partner/Verlinden

Glass floors – a current trend. For this building in Antwerp, SGG Lite-Floor by Saint-Gobain was used. The walk-on laminated safety glass can be designed in pre-stressed glass, partially pre-stressed glass or a combination of both, depending on load and bearing situation

ATTRACTIVE BUSINESS SEGMENT

Industrial glass producers, medium-sized refiners and the glass processors in the trades sector are using various approaches to introduce architects and contractors to the unique possibilities offered by glass in interior design. Swiss Glas Trösch Group, for example, operates interior design centres of excellence with exclusive showrooms that present the entire scope of interior design with glass elements. Consulting company Glas Trösch Beratungs-GmbH,

Picture: Interpane

interior design. On the one hand, several new refining technologies have been developed recently that allow for the production of completely new glass products. On the other hand, the glass industry and the medium-sized glass refiners have developed numerous creative glass ideas on the basis of these new techniques and have used systematic marketing measures to direct interest to the innovative glass products.

Refined glass products are more and more being used also for the individual design of entire wall areas. In the Grand Mall in Varna, Bulgaria, the trees added using ceramic digital printing create a special room atmosphere

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located in Ulm, regularly offers day-long designer workshops that focus on innovative glass ideas.

The internationally active glass refiner Interpane offers a comprehensive product line for interior design. The company offers sample exhibits to customers wishing to present the topic in in-house exhibitions. These exhibitions bring to life the various applications and effects of the different refining technologies.

The Internet is used intensively. As an example, for the activities of many other companies, we would like to focus on ClimaplusSecurit Group. More than 70 medium-sized refiners of Saint-Gobain glass products have joined forces in this group. On a separate Internet domain, the partner companies show what glass can do and present the entire range of glass products for interior zones. This positive development is also fuelled by the innumerable glass-processing trades operations that spark end customers' interest in interior design using glass in online presentations and in-house exhibitions.

SUCCESSFUL JOINT INITIATIVE

The many activities of the glass industry are supported by its suppliers. Fittings producers, foil suppliers and a plethora of other refining technology contractors continue to drive the trend towards glass through new products developed for glass applications for interior design and the corresponding advertising campaigns. The intensive and broad presentation of the topic has been bearing fruit. More and more, architects and contractors are choosing glass for the design of modern interior zones – in office buildings and private residences. An excellent overview of the currently available technologies for the production and refining of glass and the entire scope of glass and fittings products and their applications is offered at glasstec 2012, the foremost international trade fair of the glass industry, taking place in Düsseldorf from 23 to 26 October.

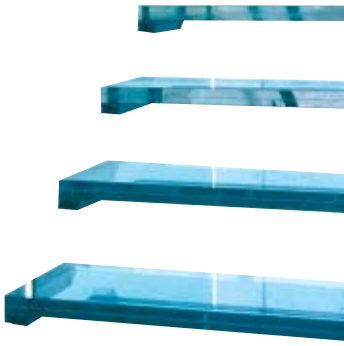
INNOVATIVE TECHNOLOGY – BUILDING BLOCK OF SUCCESS

Without the new production technologies developed by glass systems engineers, glass

Picture: Glas Trösch

Glass conference rooms emphasise the transparency and openness of companies. On request, power-driven glazing can be installed that turns opaque at the push of a button and offer a reliable privacy shield

Continuing the trend towards glass in interior zones



would have hardly been able to acquire its current position in interior architecture. Digital printing in particular has opened up completely new options for glass design to glass refiners. The printing process allows for nearly limitless glass designs. From simple graphic structures to large-format, all-over image presentation in top quality, everything is possible. A digital model is sufficient to print the desired motif quickly and easily onto the glass surface. The number of individualised applications is second to none.

Another part of the success story relates to new laminating technologies. The scope of materials that can be enclosed between two panes of glass includes razor-thin insertions of high-quality stone, wood veneer, fabric and metal textiles as well as organic inserts. This technology also uses digital printing. Just like glass, PVB foils can be printed with individual motifs and then laminated. Multi-layer glass technology is specifically well-suited for the production of glass products that require a marriage between individual design and heightened safety requirements. The glass laminate permanently protects the insertions and guarantees excellent optics as well as the necessary safety against breakage. Individual designs can also be realised for multi-layer laminates, for flooring or stair treads, for example. In addition to colour accents, light effects created by LED illuminants in particular, are currently sought after.

Most interesting for the producers of individual designer multi-layer glass are new laminating procedures that do no longer require an autoclave during the lamination process. The compact systems are relatively cost-effective and offer glass-processors in the trades sector excellent opportunities to become active in the lucrative designer glass market. Laser technology is just getting ready to enter into the industrial refinement of flat glass. Not only does it offer individual surface processing of glass, but also the application of three-dimensional interior engraving. The glass surfaces remain completely intact in the process. In addition to the fairly recent technologies in glass refining, the classic refining processes such as screen printing, sandblasting and etching continue to offer numerous options to create sophisticated design glass from simple flat glass.

By inserting laminates of coloured PVB foils, attractive glass walls and designer furniture with the specific performance features of tempered safety glass can be produced. The picture shows an exhibit by Semcoglas Company

Picture: Semcoglas Holding GmbH

NOTHING SEEMS IMPOSSIBLE

The total of the available technologies forms the base of the manifold design options. There is the right glass product for each customer requirement, no matter how unusual, manufactured to individual specifications and exact measurements. There are hardly any limits that would cramp the creativity of designers, architects and contractors in the design of glass products. This also regards the possible applications of these products.

Ceilings, floors, room dividers, doors, wall panels, stairs, side rails and furniture made of glass can be individually aligned with the room concepts. Glass products also find a wide area of application in bathrooms and kitchens. Shower cubicles, wash stands and basins, as well as radiators made of refined glass, create a sophisticated ambiance, as do glass cabinet doors, kitchen mirrors, countertops or entire kitchen fronts. Power-driven multi-layer glass with integrated crystal foils is ideal for use in conference rooms. At the push of a button, the transparent glass changes to opaque and offers a privacy shield. Even in the case of heightened security requirements, glass solutions can be used. In the form of thin tempered safety glass or laminated safety glass, the material can withstand high mechanical and thermal stress.

In all areas of application, refined glass products not only convince thanks to their attractive looks, but also due to their high level of functionality. Last but not least, easy maintenance is another argument for the use of glass in interior design over alternative materials. ■

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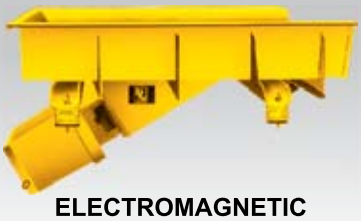

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HERMETIC SEALING AND HOT REPAIR OF SILICA CROWNS

The glass furnace life is always a major factor of a glass manufacturing unit and glass producers all over the world are continuously looking for ways to extend furnace campaign. Prof Stoyan Lutskanov* of Lubisol Engineering Co., and Jayant Shroff** of associate company Lubitech Enterprises report on a method developed for hot repair and hermetic sealing of silica crowns that has shown promising results.

The major limitation in increasing the furnace life is the life of silica crown. Therefore, emphasis is always on increasing the life of silica crowns for an overall efficient increase in the furnace life.

The alkaline corrosion of a glass furnace super structure and rat holing are often the main reasons for the premature repairs or for removing the crown insulation towards the furnace campaign resulting in higher fuel consumption and reduced pull. While, on other hands immature furnace failure due to crown results in shutting down the furnace for cold repairs which becomes even more expensive.

Since silica is and will remain the main refractory for glass melting furnace Crowns, a proper hot repair management is needed to get full life of the furnace crowns from silica bricks. But impregnation of flames along with alkaline vapors results into condensation inside the loose joints. The mechanism thus develops into formation of rat holes and these rat holes become the major cause for rapid corrosion in silica crowns resulting in short furnace life. The problem must be addressed by a proper hot repair of such silica crowns where the rat holes are already developed. Alternatively take care of the loose joints by providing hermetic sealing of the

Fig. 1: Large area of a float furnace crown sealed with Lubisol Si-Seal kit

Fig. 2: Hot repair of a container glass furnace with suspended fused silica blocks and Si-Seal kit

silica crown and prevent the formation of rat hole.

The theory was put in to practice when LUBISOL ENGG Co., developed Lubisol Si-Seal kit, designed to be applied directly over silica crown. The hermetic sealing kit has long lasting durable bond with silica crown bricks up to 1620degC and a coefficient expansion equal with the one of with silica.

Application

The Si-Seal kit is usually applied as part of the insulation in a layer of 30mm over the whole surface of new silica crowns for hermetic sealing and protection against rat-holes. This hermetic sealing protection is important for all kinds of glass furnaces, specially those melting highly corrosive glasses. Good results have been reported by various glass producers, including companies with oxy-fuel fired glass furnaces. Lubisol claims that new crowns sealed with its Si-Seal kit will have no rat-hole problem for 10 years or more.

Many hot repair applications have been carried out with the support of Lubisol's associate company, Lubitech Enterprises. The hot repairs are usually carried out by patching small rat-holes with the Si-Seal kit. For repairs of large rat-holes Lubisol recommends filling the hole with suspended fused silica blocks and sealing the whole area with the Si-Seal kit. It has been observed that when a layer of Si-Seal hermetic sealing kit has been applied over a rat-hole, the corrosion in that area has ceased.

Satisfactory results have been reported by number of Lubisol's clients making hot repairs on small and large rat-holes, including the crowns of several float furnaces in Europe, Indonesia, China and India. Lubisol and Lubitech have monitored several of these applications by regular measurements of the cold face temperature above the repaired rat-holes, which have shown no increase in temperature and no new corrosion for a period of six to seven years after repairs.

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GLASS INDUSTRY IN INDIA

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About Netscribes Inc:-

Netscribes is a consulting and solutions firm that offers investment and business research, knowledge management and communication services to meet the tactical business objectives of global clients. Our business proposition lies in providing appropriate insights to our clients to enable them in effective decision making and implementation.

Two major segments of glass industry in India are flat glass and container glass. Both the segments in India are witnessing steady growth on the backdrop of increased consumption from various sectors.

Container glass is witnessing a surge in demand from the food and beverage sector especially from the alcohol/beer industry. Higher disposable income coupled with urban lifestyle is driving this demand. As a result of which the per capita consumption of container glass is going up –however, this is still way less than the global average. In India, South India and West India are responsible for the increased demand for container glass.

Glass although is the most eco friendly packaging material it has been replaced by plastic in some non critical areas. This is even more applicable in India where the regulations about packaging are not so very stringent. These days even certain syrups are packed in plastic bottles which shouldn't happen ideally. Also the unorganized sector provides stiff competition to the organized sector. Their customers mostly the beverage companies are indifferent to the quality or the manufacturing process. As a result the onus of educating them is on the organized container glass manufacturers. Another advantage of glass is that since glass is chemically inert it does not alter the taste of the food or beverage in it-hence it does not create any health issue. In the manufacturing end glass requires significantly less energy to produce than plastic and also it can be recycled-thus bringing down the cost of purchase.

Manufacturers in the organized sector are trying to use technology in such a way which improves the inherent characteristics of glass. This will help them to compete with other types of packaging materials. They are adopting technologies like Narrow Neck Press and Blow (NNPB) which makes glass 30% lighter than the normal

manufacturing process. Another advantage the glass industry in India enjoys is that the cost of labour is relatively lower than its western counterparts making it competitive in the international arena. It has come to notice that in some cases container glass is being reused without proper sterilization- which raises serious health concern as well as the market of container glass affected as demand is getting reduced.

As a glass manufacturing unit caters to customers within a radius of 500 km it is important that they have a pan India presence in order to serve a large customer base and grab more market share- so they need to set up plants on a pan India basis. However, organized players have to often compete with unorganized players in specific regions where they have strong customer base. They also fight with them to procure the raw materials at competitive prices. High transport costs often squeeze the profit margin of the players. Institutional buyers bargain hard to get the best deal, leaving little room for the manufacturers.

In flat glass segment real estate and automobile sectors are the biggest buyers. With the advent of interior designers and MNCs who prefer glass architecture – flat glass market is also witnessing healthy growth. These days flat glass is being used even more in residential as well as commercial buildings more than ever before. Architectural glass mostly used is single paneled and it is only in special cases doubled paneled glass is used. Apart for the aesthetics purpose- glass is also being used for its additional value added properties in various uses. Number of green buildings is on the rise- which has considerably increased the consumption of flat glass-like glazed glass, reflective glass etc. Increased consumption for value added flat glass can be seen in regions like Mumbai and NCR. However, the uses of glass in retrofit buildings are strictly limited. Growth in hospitality & education sector adds to the demand for flat glass. Green buildings are getting a boost as glass helps in energy conservation as well as helps to recover the additional costs incurred in few years-thus, making the investments profitable. Green buildings with right type of glazing can save energy to the tune of (35 to 40)% when compared to ordinary glass. In modern architecture glass connotes openness- an important attribute in today's world. Flat glass is comparatively lighter than traditional brick and mortar buildings-thus putting less pressure on the foundation of the building. Also, flat glass is not as fragile as it used to be in yester years. This is because development in glass processing technology has helped the industry to make various types of glass which is much more secure and fit to be used for various architectural uses. In this market, quite a few companies have come up which provide various types of glass and glazing options for building. These companies take every precaution to meet the desired safety parameters. These companies often have to address issues pertaining to workmanship and labour problems. Growth in flat glass market gives rise to the demand of films which can be fitted to the glass for better value addition. Glass is sold directly to customers as well as through distributors.

The demand for value added glass is on the rise. Laminated glass and solar glass is likely to see a massive increase in demand. Also within the flat glass decorative glass with digital print has caught the fancy of the interior designers. Of late there is an attempt to use laminated glass in the wind shield of automobiles. If this comes into effect the demand for laminated glass will increase in a big way. Also as India tries to increase its share in green energy –solar power will play a very important role in future. As a result demand for solar glass is bound to increase. But at the same time the industry is likely to face stiff competition from Chinese counterparts and cheap imports from European Union who want to clear their inventory. Again, the US banks are giving cheap credits to solar power developers in India – who have a mandate to use products from American company. This alone can affect the solar glass manufacturers in a negative way.

Profitability of glass industry is taking a hit as the price of soda ash which forms an integral part of raw materials for making glass is becoming even more expensive. As a result, the glass industry has asked for a cut in customs duty so as to tide over the crisis. They have also requested the government to allow full CENVAT credit on capital goods. (At present it is only 50%). Also increased imports of flat glass from China is causing the Indian glass industry to suffer. The industry is also witnessing some consolidation as well as capacity expansion by the big players. The glass industry as a whole is trying to reduce the carbon emission as an attempt to save the environment. In the back end the companies are trying to employ better technologies which are more efficient and reduce wastage.

Of late some of the container glass manufacturers have moved into making of flat glass so as to capture the market in the high growth segments. Paper, metal and plastic has taken away certain amount of applications from glass - thus glass industry is trying to reinvent itself in certain areas. In last six months profitability of the manufacturers who export to foreign countries has been hit severely as the rupee has proved to be less competitive compared to the dollar. To tide over the crisis some of the companies were focusing more on their domestic sales rather than the exports. They are looking to venture into tier 2 cities for better growth opportunities. They are also looking to strengthen their after sales service and improve their product offerings. Also, some of the companies were seen to invest in their manufacturing capabilities during these turbulent times - while some others were setting up new ventures yet others were revamping their production lines. In some cases (certain categories) there has been a demand supply mismatch - where the capacity exceeds supply putting the manufacturers under pressure.

The future outlook for glass industry remains optimistic as demand from all segments is likely to pick up. The industry is also likely to gain once the laws and regulations are made more stringent and the old ones are revamped.

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Environmental and Energy priorities

Guy Tackels believes the search for energy savings and ecological footprint reduction will continue to be unavoidable components of glass manufacture.


Guy Tackels.

Looking back over the past 20 years, the arrival of numeric tools has represented an important revolution in our daily lives. Before the 1990s, we worked without mobile phones and the internet. Can you imagine using just a fax machine and a standard telephone in your professional and private lives today? Can you imagine a world without personal computers and emails, communicating within and outside your companies via these more traditional methods alone?

More recently, we also had to face up to the effects of a global economy, in particular the implications of financial, economic and energy crises. The environment is now a major and unavoidable subject and today, it is obligatory to think in terms of sustainable development. In 1992, the Bruntland report on sustainable development was confined to a small circle of specialists and the Earth Summit of Rio (1992) was an initial step towards the Kyoto protocol. For industrial emissions, we had to wait until 1996 before the creation of genuine, albeit lightweight European regulations (the IPPC Directive) whereas now, we have to deal with a wide range of legislation with far-reaching consequences for the glass industry (IED, EU ETS, REACH etc).

Our industry is manufacturing much more sophisticated products for buildings, vehicles and for packaging. Many new applications have been realised in the continuous filament sector, the CRT (cathode ray tube) has been replaced by the flat screen and glass is now playing an important role in the development of renewable energy (wind turbines and solar panels).

EVOLUTION NOT REVOLUTION

Compared to these major changes to our society, glass furnace technology may have been the subject of meaningful evolution (oxy-fuel firing for specific applications, for example) but we cannot use the term 'revolution'. Looking at energy savings and environmental compliance, it is not always easy to distinguish between progress that results from business as usual and that made under the pressure of energy costs or the latest environmental regulations. During the last 20 years, environmental constraints have increased continuously, requiring a constant reduction of furnace pollution, involving significant financial investment.

For a better understanding of furnace evolution, consider the main criteria necessary for a well-performing furnace:

- Glass quality must be in accordance with product specifications. Customers have the tendency to ask constantly for better glass quality. Less and less defects are accepted and this corresponds to higher energy demand.
- The furnace lifetime must be as long as possible, with campaigns of more than 10-12 years in container glass and above 15 years in float glass. However, we are now reaching asymptotic values for campaign durations.
- The specific pull must be as high as possible. However, many factors limit the maximum specific pull and this is often linked to furnace life. Since the beginning of the 1990s, a tendency towards stabilisation has been observed because some physical limits have been reached and they cannot be modified economically. In soda lime glass, for example, the specific pull is very much dependant on the furnace temperature, which cannot be increased with the current use of silica crowns.

>

Share your opinion with other glass industry professionals, email your opinion piece to **news@glassworldwide.co.uk**

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glass WORLDWIDE

Year	1960	1990	2010
City gas + coal	10	0	0
Natural gas	3.5	44	54
Heavy fuel oil	80	38	26
Electricity	6.5	18	20

Table 1: French glass industry energy mix, expressed in %.

- Specific energy consumption must be as low as possible.
- Tighter environmental constraints must be respected using primary or secondary methods.

In view of these criteria, I do not see room for a major evolution or even a technological breakthrough in the near future, except perhaps in the area of energy saving. The development of batch and cullet preheaters can provide some interesting solutions, for example.

In parallel, it is worth examining the evolution of the energy mix used to melt glass. The choice of energy is first influenced by economic considerations but today, the environment also plays a major role in the decision whether to use gas, oil or electricity. SOx, NOx and CO_2 emissions are indeed very much dependant on the type of energy used.

In France, between 1960 and 2010, the specific energy consumption of the total glass industry was reduced by 61%. This reduction is equal to 15% if 1990 is taken as the reference year. Figures are not available at a European level but based on information available in the last BREF, the tendency is quite similar. These reductions are due mainly to:

- Energy cost considerations.
- Glass recycling (mainly in the container sector).
- Better furnace design; better energy recovery and lower energy losses.

A definitive analysis of the last 50 years is difficult to achieve. Clearly, the most important progress took place between 1960 and 1990, at the time of the first and second petroleum supply crises. Between 1960 and 1980, energy savings were easy to realise, with attractive paybacks. During this period, with much less pressure on energy costs, less progress was made and since 2000, reductions have been observed due to more cost constraints, as well as the latest requirements on CO_2 emissions.

The evolution of the energy mix also provides some interesting information (see table 1 and figure 1). The changes observed are due to a combination of technological evolution, geopolitics considerations and environmental reasons. Several aspects must be emphasised, namely:

- The increased percentage of natural gas and electricity and the sharp decline of heavy fuel oil.
- The high level of fossil energy (gas + oil = 80% in 2010).
- Coal disappears in 1970 and city gas around 1975. Natural gas having much more attractive properties replaces these energies.
- Electricity has been stable since 1990.

What could be the evolution of this mix in the future? As mentioned in different studies conducted by the IEA (International Energy Agency), fossil fuels will continue to dominate the world's energy mix in the next 20 years. For glassmaking, I am convinced that no revolution can be expected and the use of natural gas will probably continue to increase, to the detriment of oil. There are also a few considerations to using alternative energy types, however. In the area of climate change constraint, for example, there are glass melting projects involving (partial) biogases. However, the use of large amounts of renewable energy is probably not for the immediate future. The use of green (and competitive) electricity could also change things but not immediately. That is another story!

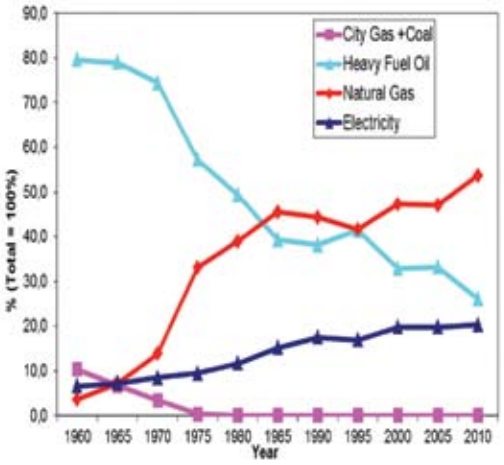

Figure 1: French glass industry energy mix.

In the meantime, due to cost pressures, energy saving remains a priority. Energy savings and ecological footprint reduction will continue to be unavoidable components of glass manufacture in a competitive environment. ■

ABOUT THE AUTHOR:
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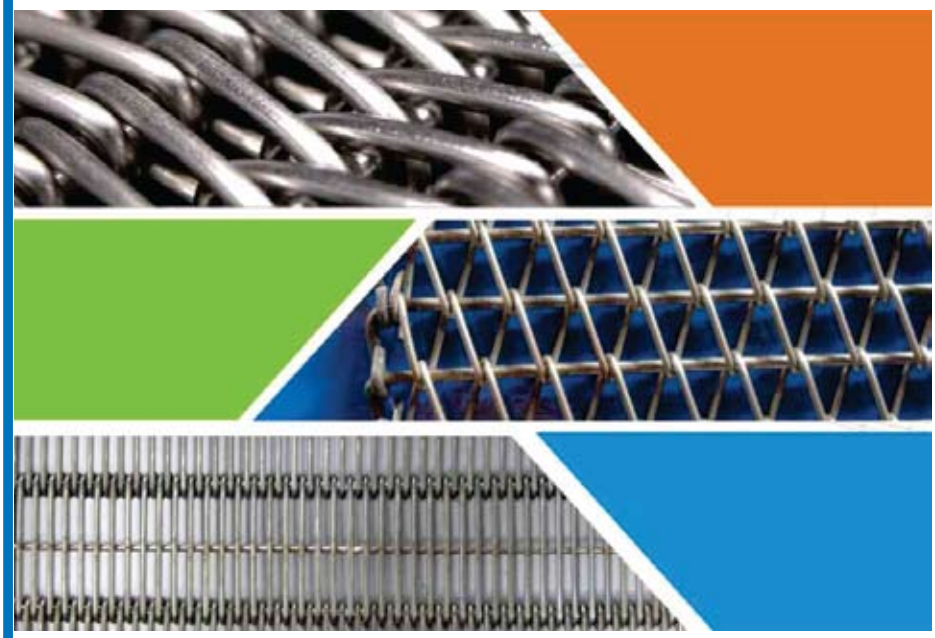

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Accelerating growth and sustainable development, along with food and energy security are amongst the most crucial challenges facing the world today. Sustainability is not only an emerging and evolving concept but also an opportunity used with increasing frequency in today's globalized business world. For quite some time now, sustainable development has been top priority on national and international agendas.

Life Cycle Assessment (LCA) has emerged as one of the preferred approaches to environmental evaluation. LCA tools started popularizing with some companies trying to find out methods not only to better comprehend their products and mitigate their adverse impacts but also to communicate their efforts to consumers. LCA is a method that provides a system-wide perspective of a product/process—one that considers evaluation at all stages of the life cycle, including material extraction and production, system manufacture and assembly, distribution, service provision, maintenance and repair and end-of-life processes.

Indian Life Cycle Assessment and Management Conference 2012: The deliberations

The Life Cycle Initiative has acquired critical mass worldwide, but is yet to acquire critical mass in developing countries like India. Federation of Indian Chambers of Commerce and Industry(FICCI)and Ministry of Environment and Forests (MoEF) in association with the United Nations Environment Program (UNEP) and The Society of Environmental Toxicology and Chemistry (SETAC) organized the Indian Life Cycle Assessment and Management Conference (ILCM) from August 22 – 23, 2012 in New Delhi.

The aim of ILCM 2012 was to share technical knowledge and expertise on the use of Life Cycle Assessment as a tool to understand and thereby manage the impact of production and consumption activities in our societies, more specifically in

terms of their environmental burden. Knowledge on Life Cycle Assessment and Management (LCA/M) could be used to enhance efficiency and global competitiveness of Indian industry, and of expanding business opportunities both in domestic and foreign markets.

ILCM 2012 brought together Indian and international experts on LCA/M, including academicians, industry practitioners and consultants, as well as bodies influencing policy both domestically as well as internationally. Mr. S G Choudhary, Chief Technology and Sustainability Officer, TATA Chemicals; Mr. Nimish Shah, Leader Safety & EAC, Hindustan Unilever; Dr. Matthias Finkbeiner, Chairman, ISO TC 207 on LCA; Dr. Sonia Valdivia, Programme Officer, UNEP; Mr. M J Goedkoop, MD, Pre Consultants, Dr. Martin Baitz, Director, PE International; Dr. Guido Sonnemann, Professor, University of Bordeaux; were among the key speakers at the conference.

The deliberations and discussions for two days revolved around the need for tools to reduce the environmental burden of economic activities, how LCA/M has actually been used by Indian industry and research community, and what could be the possible approach in promoting its application in India. The discussions brought out several impacts that are important in the Indian context. These included impacts on competitiveness of small and medium enterprises and other social impacts in addition to those on the environment.

Some of the key issues which emerged from ILCM 2012:

- **Need for efficient knowledge dissemination and capacity building**: India is still in its inception stage in implementing life cycle management on a mass scale. The reason being lack of knowledge, unorganized nature of several sectors and lack of India-specific background data needed for a robust LCA inventory.
- **Allocating resources of coercion, socialization, expertise & information:** There is a need to think, plan and act cohesively keeping the degree of expertise and information in mind. There is a lack of information and knowledge exchange LCA in India. Information exchange was one of the objectives of ILCM 2012. It provided a platform to experts, policymakers, producers, retailers and intermediaries together to explore the potential of life cycle approaches for Sustainable Consumption and Production.
- **Dynamic governance framework and pioneering thought process:** The Government has a pioneering role to play in order to employ the effectiveness of life cycle thinking in India. FICCI can act as a catalyst in bringing awareness and establish a firm knowledge base on this subject in India. In this regard, designing an

Mr.R.V.Kanoria, President, FICCI appreciated the need to apply Life Cycle principles to manufacturing and explained some examples from Chemical industry during ILCM 2012

Indian roadmap on Life Cycle Management is the immediate prerequisite to streamline the process.The industry also has an indispensable role to play by providing their valuable inputs and carve out a sustainable future for India.

A joint presentation by AIGMF and PE International on LCA Study on Container Glass Industry was given by Mr. Rajesh Kumar, Managing Director, PE International and Mr. Vinit Kapur, Joint Secretary, AIGMF.

Life Cycle Assessment Study of Glass Containers was shared with participants.

From L to R: Dr.Sanjeevan Bajaj, CEO-FICCI Quality Forum, Mr. Nimish Shah, Unilever, Mr. R V Kanoria, President-FICCI, Dr. Arbind Prasad, Director General –FICCI, Dr. Sonia Valdivia, Programme Officer-UNEP

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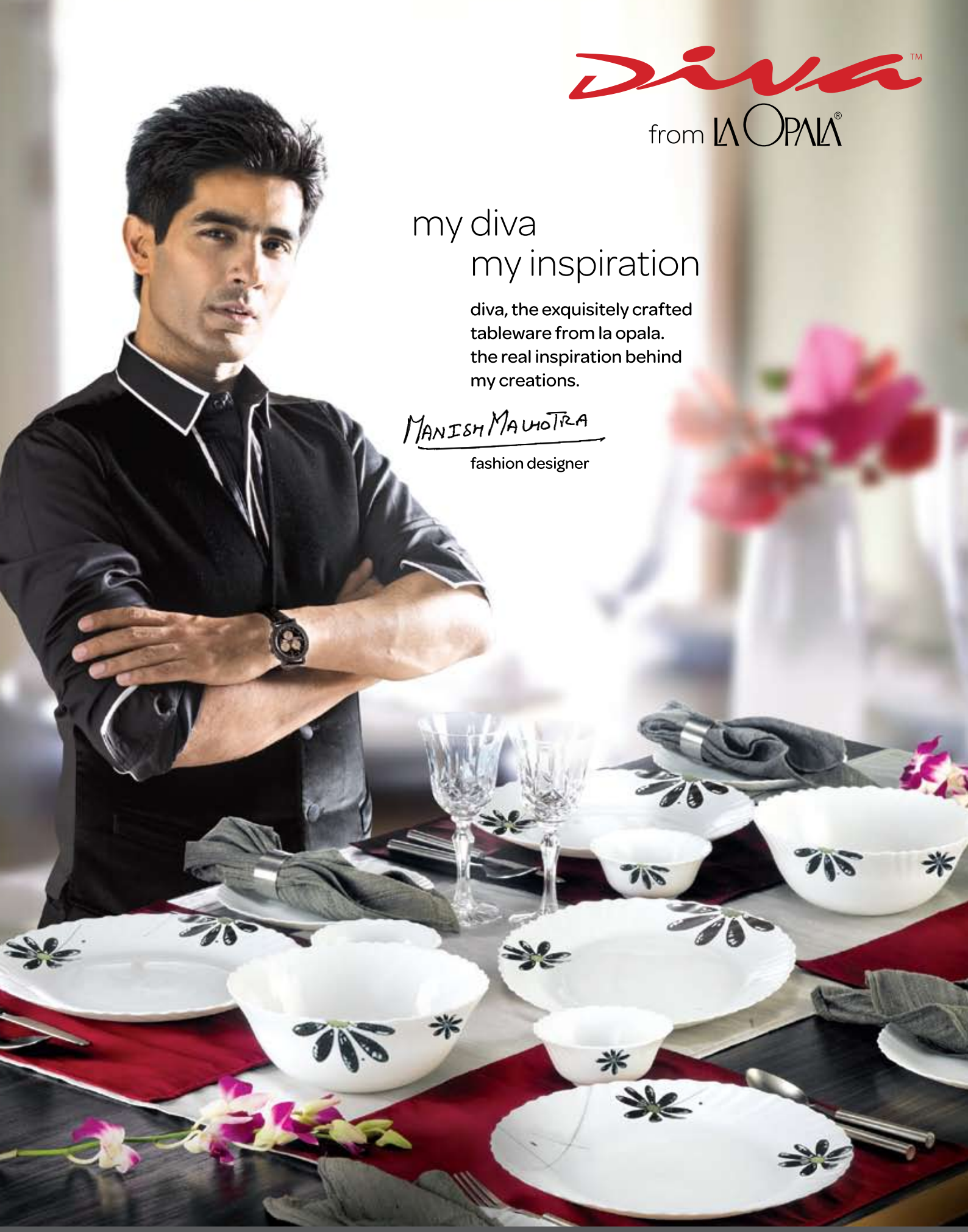

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First ISO 14040/44 compliant Life Cycle Assessment Study of "Container Glass and Comparison with Alternate Packaging Mediums (PET, Beverage Carton, Aluminum Can and Pouch) in India"

The All India Glass Manufacturers' Federation presented its prestigious first of its kind LCA study in the first Indian Life Cycle Management Conference - ILCM 2012 held in New Delhi, India organized by United Nations Environment Programme (UNEP) and Federation of Indian Chambers of Commerce and Industry (FICCI) in August 2012.

The conference provided a platform for disseminating technical knowledge on Life Cycle Assessment (LCA) and Management methodologies to promote sustainable production and consumption in India along with sharing experiences, assessing progress, promoting innovation and expanding network and cooperation.

Global Glass Packaging Industry Growth

As per World Packaging Organization, the global packaging industry is expected to be USD 597 billion by 2014 with ten year historical growth at about 3.1% CAGR[1]. Global container & packaging is a stable growth industry. Glass accounts for about 6% of the total packaging industry by value. The global market for Glass Packaging is projected to exceed US$36 billion by the year 2015[2].

Glass packaging industry in India

At USD14 billion, Indian packaging industry has been growing at ~ 15% over the last few years. It is expected to accelerate further with increasing urbanization, growing middle class and expansion of modern retail. Indian glass container market is estimated to be around USD 1.1 billion and is growing at the rate of ~ 8-10% per annum.

Entry barriers in Indian Container Glass industry is owing to capital intensive nature. Top 3 players are HNG, HSIL and Piramal Glass. Low per capita glass container consumption of 1.5 kg in India as compared to other countries. India is amongst the top 15 markets for glass packaging globally and 3rd fastest growing market after Turkey and Brazil.

Environment and Health benefits:

Glass has many health's and environmental benefits which makes it a better option in packaging industry. Some of the examples are:

- Glass is made from abundant raw material - It is either made from cullet or a raw material which easily available and locally procured.
- Glass is inert - It does not react with any kind of packed content packed and is thus a 100% neutral packaging medium.

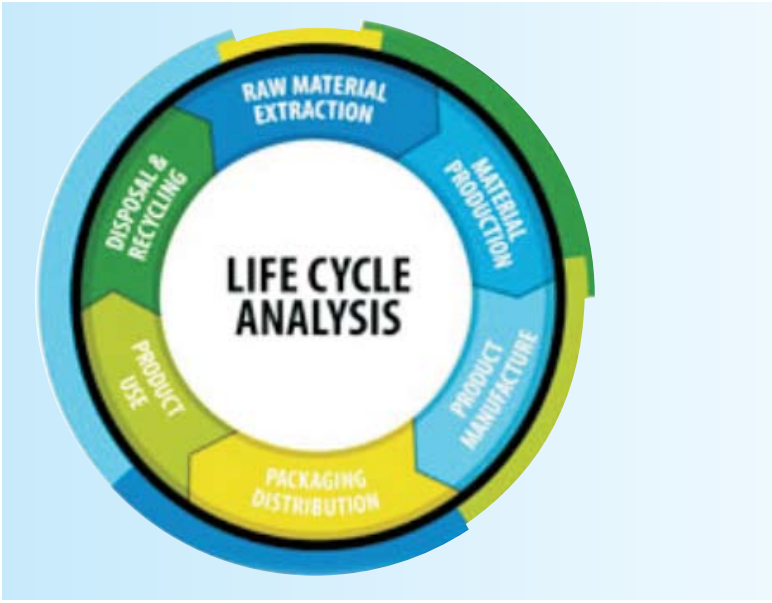
[1]Source: Owens-Illinois, Inc. - Investor presentation

[2]Source: Global Industry Analysts, Inc.

- Glass is non-porous - It does not allow water and air to seep through and thereby it offers the highest shelf life to packed content.
- Glass is safe & healthy - Glass has been proved to be safe and healthy for consumers and the environment for more than 3,000 years.
- Glass is irradiated - It is the best packaging material for sterilised products.
- Glass is recyclable - It is 100% recyclable. It does not lead to generation of any solid waste, thus saving land fill space.
- Glass is resistant to chemicals and solvent - It is used for packaging of chemicals and solvents as it does not react with them.
- Glass ensures hermetic seal - It provides air tight packaging for products thus providing longer shelf life. It is the most preferable product for vacuum and carbonation.
- Glass is transparent - The customer is afforded the facility of visually examining the content from outside the pack.

Life Cycle Assessment Study

AIGMF engaged PE Sustainability Solutions Pvt. Ltd. (PESSPL), a 100% Indian subsidiary of PE International AG, Germany, an independent consulting company with extensive experience in conducting Life Cycle Assessment (LCA) studies and facilitating critical review processes according to ISO 14040/44. PESSPL conducted this LCA study for AIGMF and also carry out the comparison with various alternate packaging materials such as PET, beverage carton, aluminium can and pouch. In the past PE International already conducted Life Cycle Assessment Study of the environmental performance of container glass production for Glass Packaging Institute (GPI) and European Container Glass Federation (FEVE) representing member companies in North America and Europe respectively.



Objective

Goal

The goal of the study includes:

- Understanding the environmental impact of container glass – focusing on cradle-to-cradle assessment (including raw material extraction to manufacturing and end-of-life recycling).
- To identify and investigate potential improvement opportunities for container glass packaging.
- To identify and quantify the impacts of alternative packaging solutions such as PET, beverage carton, aluminium can and pouch.

The life cycle assessment is an original ISO 14040/44[3,4] compliant study. Consistent methodology and modelling has been used for this study which is also specific to India.

Critical review process

The review was performed according to ISO 14040 and ISO 14044 in their strictest sense as the data provided by the study are intended to be used for comparative assertions intended to be disclosed to the public. In order to allow credible communication based on the results of this study,

[3]ISO 14040: Environmental management – Life cycle assessment – Principles and framework (ISO 14040:2006); German and English version EN ISO 14040:2006

[4]ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines (ISO 14044:2006); German and English version EN ISO 14044:2006

a third party critical review panel comprising three independent experts:

- Prof. Dr. Matthias Finkbeiner, Technische Universerität Berlin - Department of Environmental Technology - Chair of Sustainable Engineering (Panel Chair)
- Mr. Matthias Fischer, Head of Department - Life Cycle Engineering, Fraunhofer IBP and University of Stuttgart, LBP and
- Mr. V S Mathur, General Manager, Quality and Environmental, Crop Nutrition and Agri Business, Tata Chemicals Limited, Babrala, India.

Life cycle stages

The life cycle stages of product systems that were studied included:

Cradle-to-gate production of raw and relevant ancillary materials needed for the manufacture of container glass and alternative packaging;

Transports of relevance over the life cycle of the glass containers and alternate packaging under study;

Manufacture of container glass and alternative packaging and

End-of-life of glass and alternative packaging containers covering recycling (open and close loop), reuse and disposal.

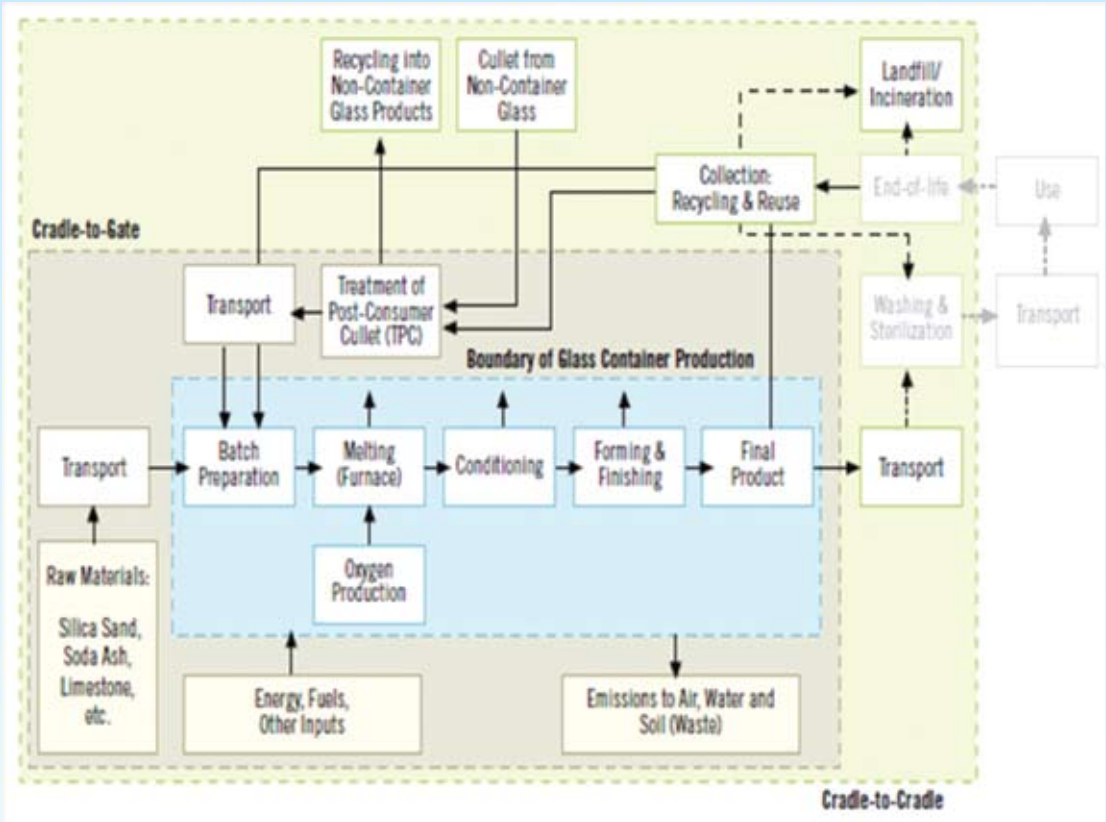
Functional Units

The functional unit for the base case was defined as packaging 180 ml of liquor in glass, PET, beverage carton and pouch. Accordingly other functional units were also evaluated for different combination of materials.

Software

The LCA model was created using the state of art GaBi 5 Software system for life cycle engineering, developed by PE International AG. The GaBi database provides the life cycle inventory data for several of the raw and process materials obtained from the upstream system.

Life cycle flow diagram



Source : Environment Overview Complete Life Cycle Assessment of North American Container Glass
http://www.gpi.org/downloads/lca/N-American_Glass_Container_LCA.pdf

Sensitivity Analysis

For 180 ml packaging size of all packaging systems, three sensitivity analyses have been performed in order to assess the influence of different parameters.

Transport distances

A sensitivity analysis is conducted for the transportation of primary packaging to the filling station for distances of 500km and 700 km.

Weight of the packaging medium

A sensitivity analysis is conducted for a variation in weight of the primary packaging ranging from -20%, -10%, +10% and +20%.

EoL share of recycling

A sensitivity analysis is conducted for variation in the recycling rates of the primary packaging for 50% and 75%. The materials, which are not recycled, are considered to be land filled.

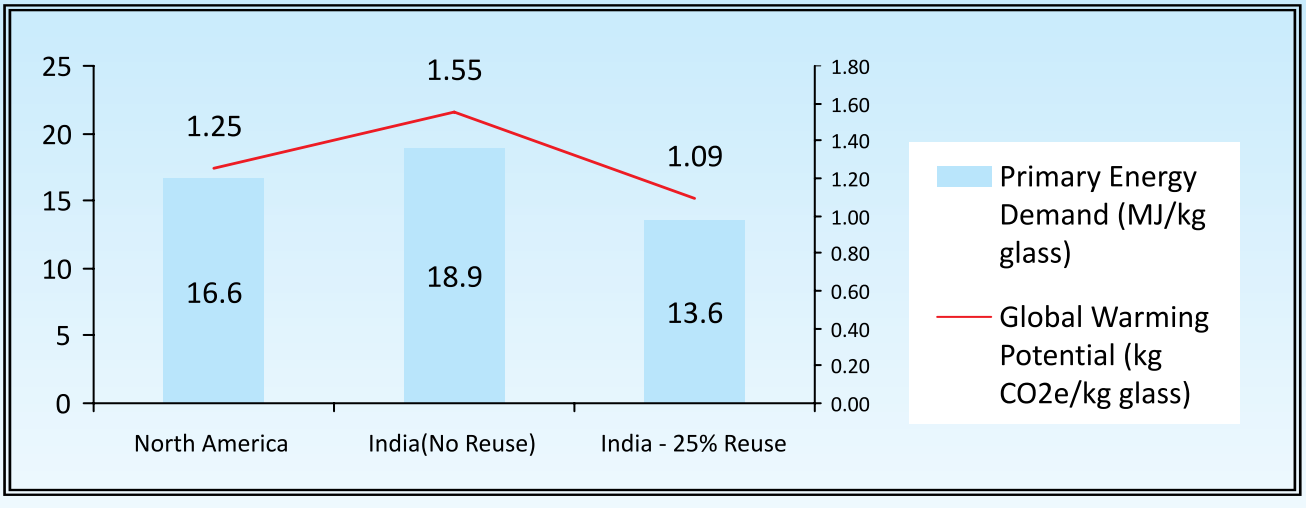
Results and Interpretation

CML 2001 (Nov 2010) method has been selected for evaluation of environmental impacts. These indicators are scientifically and technically valid. The cradle to cradle environmental impacts for 1 kg of formed and finished glass is shown below in the table:

This study vividly reflects that improvement in recycling coupled with reduction of weight of glass containers would certainly lead to significant reduction in environmental impacts which will place it in a better position in comparison to alternative packaging systems despite higher weight of the glass for the same functional unit as compared to alternative packaging systems.

CML2001 - Nov. 2010	Cradle to cradle LCA of 1 kg Glass
Acidification Potential (AP) [kg SO2-Equiv.]	8,3E-03
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	6,0E-04
Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	1.09
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	0.19
Photochemical. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	3,2E-04
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	2,6E-03
Primary energy demand from renewable and non-renewable resources (net cal. value)	13.60

The above mentioned study depicts that Indian container glass industry is performing at par with the North American glass Industry[5]



Source: Environment overview: Complete life cycle assessment of North American Glass, GPI; www.gpi.org

The cradle to cradle environmental impacts for 180 ml container glass is shown below in the table:

CML2001 - Nov. 2010	Cradle to cradle Glass 180 ml liquor
Acidification Potential (AP) [kg SO_2-Equiv.]	**1.2E-03**
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	**9.4E-05**
Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.]	**1.6E-01**
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	**3.4E-02**
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	**4.7E-05**
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	**4.2E-04**
Primary energy demand from ren. and non ren. resources (net cal. value) [MJ]	**2.3E+00**

Comparison of glass with alternative PET packaging system

Comparison of 180 ml Glass with Alternative Packaging Systems

	Glass Ref	Glass (-20% W)	Glass (75% R)	PET Ref	PET (-20% W)	PET (-75% R)
Acidification Potential (AP) [kg SO_2-Equiv.]	100	82	66	60	49	58
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	100	83	67	69	58	66
Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.]	100	82	61	57	47	52
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	100	85	85	123	104	123
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	100	82	57	136	111	110
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	100	83	65	246	201	177
Primary energy demand from ren. and non ren. resources (net cal. value) [MJ]	100	84	69	74	63	64

Improvement in the performance indicator due to weight reduction and improved recycling

CML2001 - Nov. 2010	Weight reduction (-20%)	Recycling (75%)	Weight reduction (-20%) & Recycling (75%)
Acidification Potential (AP) [kg SO_2-Equiv.]	18%	40%	45%
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	17%	37%	44%
Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.]	18%	39%	50%
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	15%	15%	27%
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	17%	35%	52%
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	18%	43%	45%
Primary energy demand from ren. and non ren. resources (net cal. value) [MJ]	16%	31%	41%

Recommendations

Glass

- This assessment reflects the existing technical situation for the year 2010-11 representing 72% of the Indian production volume representing both large and small manufactures. Conditions of furnaces, due to the increasing use of abatement systems, efficiencies, rebuilds, and cleaner technologies, etc. will change over time affecting the energy and material inputs and subsequent emissions of container glass manufacturing.
- Glass industry should look for ways to strengthen glass through new surface treatment and better design without sacrificing improvement in material reduction. New technologies such as Narrow Neck Press and Blow (NNPB) forming process can help in such light-weighting efforts. Reduction in weight of glass will reduce material consumption and melting energy needed during the production stage. It will also reduce fuel consumption during transportation stage and increase in strength of glass increase number of reuse. This will lead of improvement of overall LCI profile of glass.
- Increase in cullet recycling rate will reduce direct material consumption and melting energy hence the overall LCI profile of glass. Better waste management for improvement of collection and segregation of glass and increase in number of cullet treatment plants (CTP) across the country will help in this.
- To improve the overall waste management system it is important to involve all the stakeholders and create awareness. Partnership with various NGO to conduct training and create awareness for the entire stakeholder should be done.
- Change of fuel from furnace oil to natural gas will significantly reduce the environmental impact and LCI profile of glass.
- Use of renewable energy like solar energy or biomass for production of electricity should be considered at bigger installations.
- Reuse of secondary packaging should be increased.

PET and Pouch

- Open dumping of PET and Pouch should be strictly prohibited.
- New environmental laws should be enacted for proper waste management of PET and pouch to reduce littering and unorganised dumping which sometimes also leads to cattle intake. Milk consumption from such cattle is dangerous to human health.
- Safer technologies for PET recycling should be promoted, in the absence of which leads to environmental degradation.
- PET and other plastics like HDPE, LDPE and Polycarbonate having bisphenol, a leach into food and beverages even at room temperatures especially when aerated and other drinks are stored in them. Hence proper care should be taken from manufacturers in food and beverages packaging.
- If recycled plastics (thermoplastics) are used even in small quantities in the manufacture of food and beverages packaging, they may cause harm to human health as the contaminated recyclate can leach toxic hydrocarbons such as pesticides, fertilizers, lube oils, paints and heavy metals into the edible contents packed in them. Hence proper care should be taken from manufacturers in food and beverages packaging.

Beverage Carton

Since methane is generated during the decomposition of paper and carton, a proper waste management should be to promote recycling and avoid landfill.

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PTA SURFACING OFFERS COST-EFFECTIVE MOULD PROTECTION

Applying an optimised coating for glass container moulds is a cost-effective way to improve productivity. Plasma Transferred Arc (PTA) surfacing is widely used in high-volume automated applications. Höganäs offers high-quality metal powder consumables and process expertise to maximise the benefits of PTA surfacing.

Moulds are used in glass production techniques such as "blow-blow" for the manufacture of bottles and "press-blow" for the manufacture of jars and other containers. Hollow glass production exposes moulds to an aggressive environment with high temperatures.

A considerable investment is often involved in moulds for plungers, bottom plates, rings, sealers, baffles, blow heads, guide rings, neck rings and holders. An effective way of protecting that investment is to apply an optimised coating to moulds used in mass production lines.

An effective coating can provide protection against wear and corrosion and restore worn or damaged parts to their original condition. It is a cost-effective procedure, as productivity is highly dependent on mould life and high-quality product finish depends on immediate replacement when signs of mould wear are first detected.

Each shape and form in glass production requires a unique tool set to achieve the final product shape. A tool set consists of a range of components, each with a specific demand for protective surfacing. Each component may require not only different powder consumables, but also different application techniques.

Application techniques

The range of techniques used to protect moulds can be divided into two main categories: thermal spraying and welding. Laser cladding, a relatively new alternative, is expanding the choice of application techniques.

Thermal spraying methods such as flame spraying and HVOF (High Velocity Oxygen Fuel) techniques are commonly used on plungers, see Fig. 1.

Powder welding techniques and Plasma Transferred Arc (PTA) surfacing are used to apply protective surfaces to bottom plates, blow heads, guide rings and neck rings.

The edge sections of neck rings can be sensitive to wear and lose definition. Powder welding or PTA are commonly used to apply nickel-based alloy on these surfaces. The finish achievable after final polishing is shown in Figs. 2 and 3.

PTA is a welding process, see PTA overview Diagram 1, and identifying the correct welding parameters such as deposition rate, plasma gas flow and current level is vital for achieving consistent high-quality coatings with the required surface properties for wear and corrosion resistance.

PTA surfacing functions well in automated production where consistent, high-quality coating is required, due

Fig 1. Plungers after surface deposition.

Fig 2. Neck ring component.

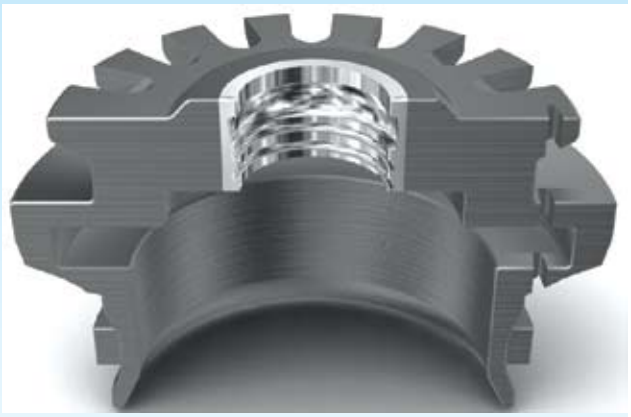

Fig 3. Screw cap neck ring component.

to the continuous addition and uniform flow of filler powder, the good melting qualities of powder particles and accurately controlled heat input.

As well as being highly consistent, PTA deposits are very smooth, which reduces the need for excessive machining, see Fig. 4. This lowers total costs by increasing productivity and reducing tool- and labour-related costs.

The right consumables

Specialist expertise is required to select the right powder consumable to satisfy an application's wear and corrosion resistance requirements. Höganäs helps customers to identify the user-specific consumable that delivers the correct alloy and particle size for the particular mould function and equipment.

Metal particle size and the morphology of the particle itself are important for achieving the smoothest possible flow. Perfect spheres avoid clogging, as every irregularity or satellite – a fine particle attached to the spherical surface – can potentially fasten, resulting in a build up of material that either releases and sputters unevenly or causes clogging. Any satellites that detach during welding

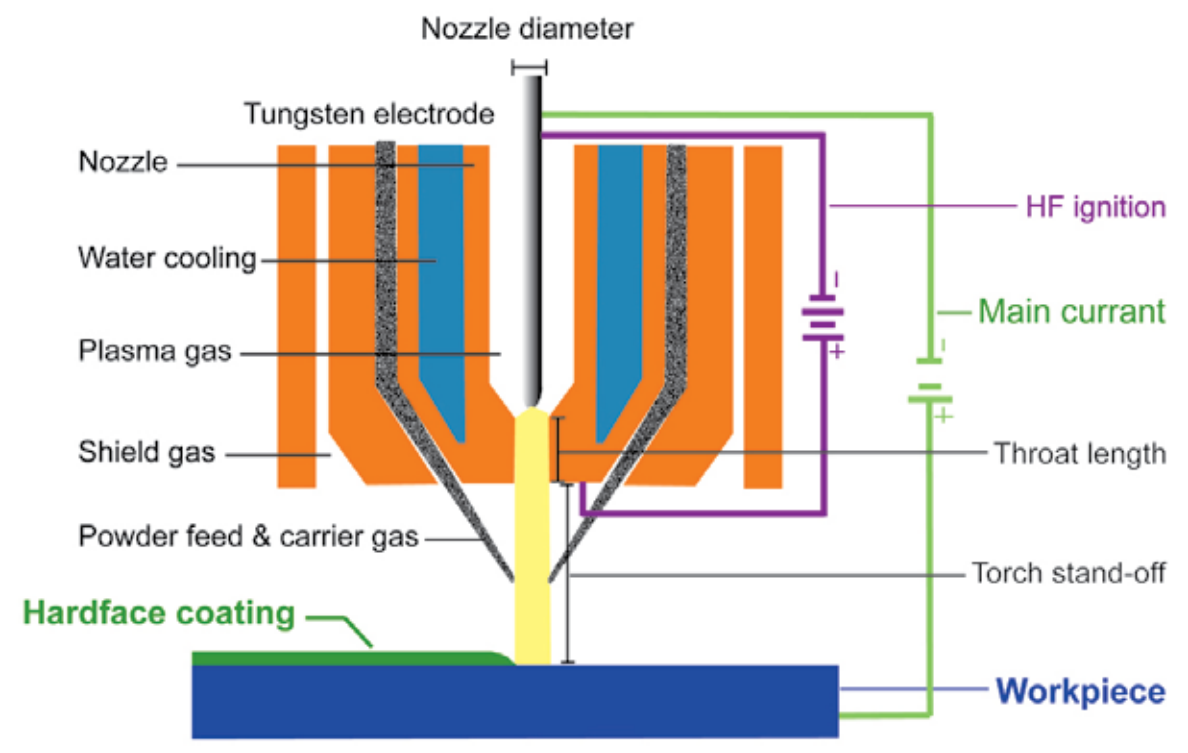

Diagram 1. The Plasma Transferred Arc (PTA) welding process.

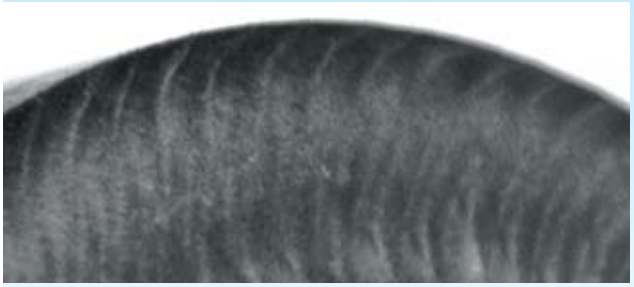

Fig 4. Smooth finish a characteristic of PTA.

also increase the fines in the feedstock and, as fines melt more rapidly, this affects the process.

Low porosity is required in the finished surface layer. Hollow powder particles can contribute to porosity in the final surface, thus the feedstock powder should consist of solid spheres without internal pores.

Powder consumables with round particles can therefore play a vital role in achieving smooth and continuous flow in the automated PTA Unit. In fact, this is essential for achieving the required properties and process efficiency in hollow glass production.

Höganäs powder consumables are characterised by spherical particles (Fig. 5) free from hollow spheres and satellites. These spherical particles ensure better flow, enabling processes with fewer fines and less clogging. The smooth and even powder flow results in less porosity, more even bonding to the base metal and a higher deposition rate.

The uniform morphology of spherical particles also enables consistency between batches. This means the same machine parameters can be used on equipment, so no time is lost when changing between batches, and this can contribute to higher productivity.

Low oxygen content is a major factor in achieving better and cleaner surfacing. Consumables with an oxygen content of are common, but monitoring to maintain 250 ppm can also contribute to high surface finish and cleaner welds. As Höganäs powders are gas atomised, rather than water atomised, they are low in oxygen, at around 250 ppm.

Profiting from optimised parameters

Adjusting or changing parameters in production can be profitable. A specific example of this, shown in Table 1, is based on an automated PTA unit. Good powder flow can bring cost-savings, because

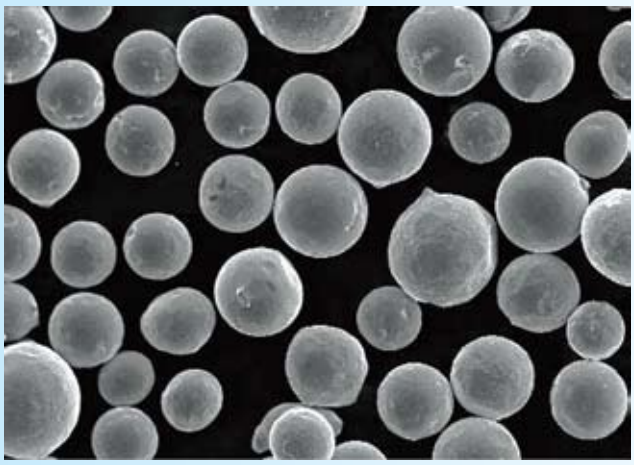

Fig 5. Spherical particles for smooth flow minimises sputtering.

less gas is required to transport the same quantity of powder. Reducing from 8 to 6 litres/minute represents 25% lower gas consumption with the same productivity. In the case of PTA this can be quantified, but the principle also applies to other equipment where lower gas pressure can be used.

Table 1. Optimised particles and parameters on a PTA unit

PTA	Round particles	irregular particles
Gas consumption	6 litres/minute	8 litres/minute

Dilution control

Good powder flow is also vital for effective dilution control. As PTA is a welding process, the bond zone is subject to dilution as the surfacing alloy is merged with the substrate alloy. Dilution control is therefore essential to achieve a good finish with the required surface properties.

During the start sequence the plasma gas and powder feed are ramped up over time (1-10 seconds) to ensure a smooth start. A balance must be maintained between heat input and powder input during this "up slope" sequence.

The same applies on the "down slope" during completion at the end of the welding. If settings are not correct during the up or down slope there is a high risk of bonding errors, pores, cracks, surface defects and other flaws in the deposit.

The complexity encountered when setting these critical parameters is shown in Fig. 6, which indicates how dilution is influenced by deposition rate, plasma gas flow and current level.

Höganäs powder consumables, with round particles free from satellites and hollow spheres,

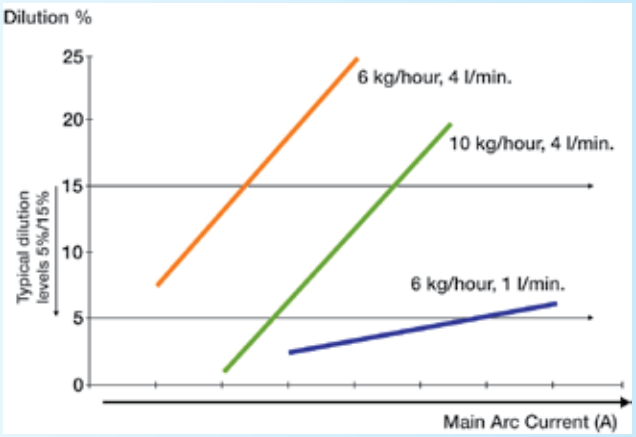

Fig 6. Influence of deposition rate, plasma gas flow and current level on dilution.

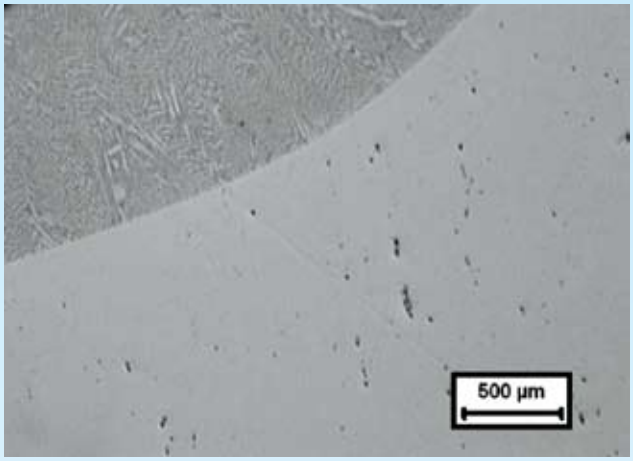

Fig 7. Bond zone of PTA deposit.

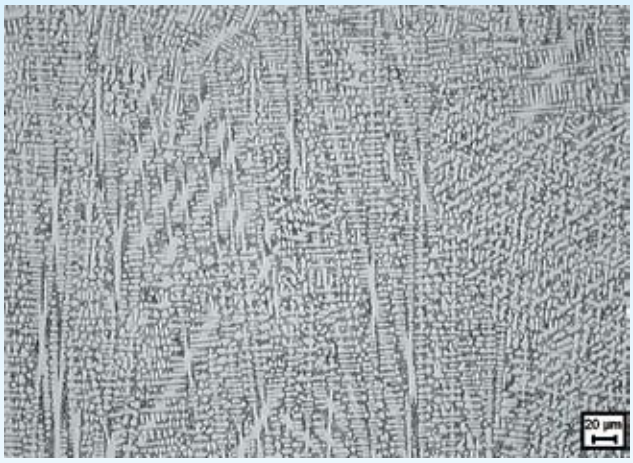

Fig 8. Deposition structure.

ensure a steady powder flow and smooth melting process. This means a lower current can be used and this in turn has a positive effect on dilution. Lower dilution levels allow the application of a thinner coating as the required chemistry is reached.

The initial dilution as the powder contacts the substrate is a positive step, as it ensures the applied coating material merges with the substrate to achieve excellent bonding and adhesion strength. See Fig. 7.

This surface alloy generates the required hardness properties for resisting wear and corrosion, see Fig. 8.

A profitable partnership

Profitable process enhancements are more easily implemented in a partnership. The powder consumable and process parameters must be considered together to achieve an optimised result for excellent mould performance.

Höganäs, a long-established supplier of powder consumables for a wide range of industries, fully applies its core competence in metal powder technology in its thermal spraying and welding solutions. The company began producing iron powders nearly 100 years ago and has become the world's largest metal powder manufacturer.

The company has extensive laboratory resources for evaluating material behaviour related to thermal spray and PTA techniques, using metallography and other analysis methods to ensure a better understanding of all facets of the process.

Höganäs provides a range of services including on-site technical support, on-site training and troubleshooting to fine-tune the process and powder feedstock to achieve high quality results and profitable improvements.

Finding the optimum PTA or thermal spray solution can be a complex process, as many factors are involved. Höganäs offers the experience and expertise to help its customers find the right powder consumable and achieve the control of parameters needed for excellent thermal coating solutions.

PTA – a cost-saving solution

- PTA surfacing prolongs mould life and boosts productivity
- PTA surfacing can be highly automated to maximise process benefits in mass production lines
- Optimised powder flow brings cost-savings, as less gas is required to transport the powder
- Smooth deposits reduce machining requirements and eliminate related costs

Discover more about the Höganäs offering for thermal surfacing at: www.hoganasthermalspray.com

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PLANETARY PAN MIXER

Planetary mixer is engineered and built to meet the modern glass industry requirements of efficient mixing and mix designs that are becoming ever more complex.

The concept of Planetary Pan Mixer was initially developed in Germany and further evolved in Denmark, as the Ring Trough mixer was not giving expected results on high-quality mixing.

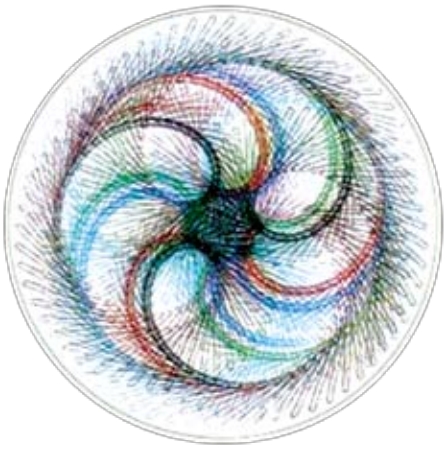
Planetary mixers instead, succeeded in mixing high-quality materials.

Compared to the Ring Trough mixers or "Turbo mixer" the concept of Planetary Pan Mixers changed the market dynamics completely. Here, the gearbox with the rotating star/s, mixing tools is placed directly on top of an empty pan, and the loaded material is able to fill the complete area of the vessel.

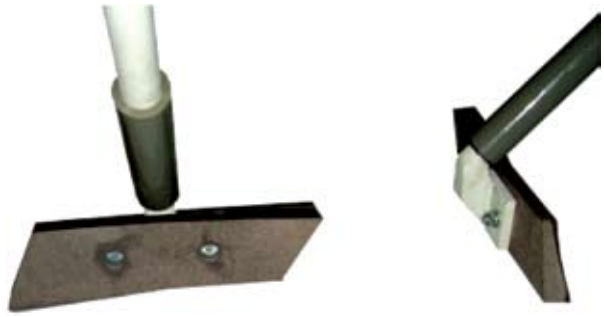
A typical empty vessel found in Planetary Pan Mixers

The planetary mixer mixing tools rotate in a synchronized manner and are able to turn the material distributing all of the material uniformly in the pan without favouring the different nature of the materials creating a homogeneous mix; each revolution changes the flow pattern.

The mixing arms and tools cover the complete area, thereby ensuring a homogenous mix



An inside view of the mixing action.....



..... and blades all of the same reversible geometry.

The intensity of the mixing action, appropriate speeds combined with design of the mixing tools provide a complete homogenisation and an efficient flow pattern.

Some basic differences determine the quality of the mix and the time to achieve a proper mix; the mixing tools geometry and diameter of the mixing vessel.

Today's modern glass industry with more stringent mix requirements can find in the Planetary mixer a valid ally to front and achieve such demands.

More industries are going through a modernization of their equipment, a planetary mixer is first choice, and the general benefits are seen immediately.

The mixer gearbox has been specifically designed for planetary mixers; it is not an adaption or an add-on to an existing design. It is a high quality purposely-built unit that has been designed and manufactured to be used only for heavy duty mixing.

The mixing action taking place evenly over the entire area of the pan is designed to ensure that the mixing blades movement completely covers the entire free surface of the mixer unit.

The unique rhomboid shape of the mixing blades together with the synchronized action achieves a high degree of homogeneity of the mix in a comparatively short time.

All of the dustproof movable covers are fitted with safety limit switches to stop the mixer if they are opened, which ensures a safe maintenance; the hydraulically operated discharge gates discharge material rapidly.

Quality materials are used for the on-board engineering and all of the components on the planetary mixers; the result is a sturdy, reliable, state of the art unit that embodies high quality, functional design and user-friendly operational features."

Contributed by Ajax Fiori Engineering (I) Pvt. Ltd.
www.ajax-fiori.com

A CENTENARY OF GLASS EDUCATION AT INDIAN INSTITUTE OF TECHNOLOGY (BANARAS HINDU UNIVERSITY) VARANASI, INDIA


Devendra Kumar


Om Parkash

Devendra Kumar
Professor of Glass Technology and
Om Parkash
Professor of Electrical and Electronic Ceramics
Department of Ceramic Engineering
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Varanasi known as Banaras or Kashi is city of knowledge of Indian sub continent from the ancient days. Towards the end of nineteenth century and beginning of the twentieth century people of India started their movement against the colonial British rule. Many spiritual and political leaders were struggling hard for all round; cultural, educational, economic, social and political up liftment of Indian Nation. Mahamana Pandit Madan Mohan Malviya, a close associate of Mahatma Gandhi, in his nationalist movement, with multifaceted personality was also an ardent journalist, a successful parliamentarian, an outstanding statesman, a social reformer and great visionary. He realized that education is the key to all kinds of developments and reforms. The education with roots in ancient traditional knowledge and heritage and having pace with modern advancement in science, technology and engineering will help in making the country to withstand the global community. He along with other contemporary great leaders like Annie Besant formed the Hindu University Society on 22.11.1911, got Banarans Hindu University Bill passed in October 1915 and founded the University on 04 February 1916. Mahamana Pandit Madan Mohan Malviya was a Member of Industrial Commission of India during 1916-18. Being well acquainted with the industrial revolution he founded Banaras

Engineering College as a part of University in1919.

During the period of establishment of the University, many advancements were taking place in different disciplines of science and engineering. Universities were becoming the centers of innovations and knowledge generation. In the era of sixteen to nineteenth century, ceramic and glass industries were transforming from small and medium enterprises to large enterprises. Glasses which were earlier manufactured in pot furnaces in small quantities started being made in large quantities by melting in continuous tank furnaces. There was also growth of diversified applications of glasses ranging from art wares or articles to laboratory wares, window panes and ophthalmic lenses etc. Mahamana Malviya was very much aware of the importance of these ceramic and glass engineering subjects and their impact on the development of society and nation. He established two departments under Industrial Chemistry section; Department of Glass Technology and Department of Ceramic Engineering in the year 1924 with the noble objective of advancing glass and ceramic technology in India. These departments have done pioneering work in the Ceramic Engineering and Glass Technology education for three decades. Large number of graduates from these departments became entrepreneurs and led to the growth of ceramic and glass industries in India. In the Year 1956, Department of Glass Technology and Department of Ceramic Technology were amalgamated to form the Department of Silicate Technology.

In 1947 India became independent from the British rule. To boost higher engineering and technology education in India, Indian government started establishment of Indian Institutes of Technology in different parts of country with the aid of the Universities of five developed nations e.g. U.S.A., U.K., Germany, France and Russia. With large number of scientific and technical innovations in first half of twentieth century, the focus of engineering education has changed from engineering to technology. Keeping with the pace of National and International Engineering and Technology education, the three engineering colleges of

Banaras Hindu University; Banaras Engineering College, College of Mining and Metallurgy and College of Technology were amalgamated in1968 to constitute Institute of Technology. At the same time Department of Silicate Technology was renamed as Department of Ceramic Engineering. Over the last five decades Indian Institutes of Technology have emerged to be known as Institutes of advance learning, research and training in Engineering and Technology nationally and internationally. To increase the family of these Institutions and to provide education to large number of students in these institutions, Government of India has established a few more IITs and converted the premier Institute of Technology of Banaras Hindu University into Indian Institute of Technology (Banaras Hindu University), Varanasi on 29th June 2012 by amending its Institute of Technology Act of the Parliament.

The Department of Ceramic Engineering is presently offering a four year B. Tech. degree, five year B.Tech.-M.Tech. dual degree, two year M.Tech. degree and Ph. D. degree courses in Ceramic Engineering. The department is teaching all types of graduate and higher level theory and practical subjects in glass and ceramic science and technology. For glasses these include ceramic raw materials, fuels furnaces and pyrometry, phase equilibrium diagrams, glass and glass ceramic technology, materials characterization techniques, refractories , industrial furnaces and project design. Approximately three hundred students study here. The Department is having five traditional ceramic sections; pottery and heavy clay wares, cement, ceramic coatings, glass and refractories and four advanced ceramic sections; electrical and electronic ceramics, glass ceramics, bioceramics and ceramic processing and nano-technology. The Department is pursuing active research in different emerging areas of ceramics and glass science and technology. The graduates of this department are in high demand in different glass, ceramics, cement, refractory and information technology industries. Every year some graduates go abroad for higher studies. The graduates are spread almost all over India and world.

Glass manufacturing skills were traditionally developed as an art. Traditionally plain and coloured glasses are manufactured as decorative items and bangles. The use of glasses in ophthalmic lenses, laboratory and house hold wares and different lighting lamps has expanded their application area. Glass manufacturing in India is supposed to be started as clusters of small scale industries like Firozabad in Uttar Pradesh. The main emphasis was to produce a variety of glass with different beautiful colours, with good durability and strength. Glass manufacturing was concentrated in

melting glass in pot furnaces and efficient working. The Department of Glass Technology (1924-56) and Silicate Technology (1956-68) at Banaras Hindu University, Varanasi was having all infrastructure and expertise for manufacture, development, education and training for such glasses. The name of Professor Rama Charan can be remembered for his scholastic effort for education and training of young budding glass engineers and developing many glass compositions for different applications. He compiled his work on glass technology in his books on the subject.

Towards the end of nineteenth century and beginning of twentieth century the production of flat and figured glass has seen many technological and engineering modifications. Melting of glass in continuous glass tank furnaces with many fold increase in the production rates from a few tons to hundreds of tons per day was seen as a challenge. The development of Boudin process and other processes for rolled and wired glasses and Fourcault, Colburn and PPG Pennvernon processes for flat glasses was only possible by engineering the melting process of glass in the tank furnaces. The study of redox equilibrium in molten glasses is an important area of glass melting technology research which helps in understanding the colouring and refining processes during glass melting. The second era of glass science technology education and research at Department of Ceramic Engineering began with the joining of Professor Prabhu Nath in 1969, who completed his Ph. D. with Professor R. W. Douglass at University of Sheffield, United Kingdom with pioneering work on study on redox equilibrium for different multivalent ions in glasses. His work at Sheffield and Department of Ceramic Engineering was very valuable contribution for science and technology of glasses. Many people have done Ph. D. under his supervision and numbers of Indian glass industries were benefited with his valuable consultation.

During the middle and later part of the century, large number of scientists and technologists became interested in investigations of non conventional characteristics and application of many new glass systems. Chalcogenide and metallic glasses were invented. These show electrical conducting characteristics. Many oxide glass systems containing transition metal ions became important for their semiconducting characteristics. Glass ceramics, new materials, were innovated, which are being produced by controlled crystallization of selected glass systems by suitable heat-treatment. With the control of phase and microstructure of glass ceramic materials, one can engineer their electrical, mechanical, thermal and optical characteristics for multifunctional applications. Bio-glass and glass ceramic materials are also being developed for

human body implants. The Department of Ceramic Engineering at Indian Institute of Technology (Banaras Hindu University) is presently focusing its research, development and teaching effort in large number of emerging frontier areas of glass and glass ceramic science and technologies. Although the faculty strength of the department is small, however, glass and glass ceramic group is very active and strong. Prof. S. P. Singh, Prof. Ram Pyare and Dr. Anil Kumar are continuing to work on redox equilibrium in glasses along with investigations of 45S5 glass and glass ceramics for bio applications. Prof. Devendra Kumar and Om Parkash have concentrated their effort for the study and development of glass and glass ceramics for different electronic and photonic applications for the last three decades. Barium titanate and related ceramic materials are an important class of electronic ceramic materials. It is very difficult to grow their crystals in glass matrix. Prof. Devendra Kumar and Om Parkash have developed glass compositions where undoped and solid solution lead and strontium titanate crystals can be grown in borosilicate glass matrix with controlled heat treatment forming glass ceramics. These glass ceramics show high dielectric constant. Their dielectric characteristics can also be changed by doping in a similar fashion as electronic ceramic materials. Optically active rare earth doped glass ceramics have also been investigated for their phosphor and up-conversion characteristics. The department is having all the facilities for research and development in the area glass and glass ceramic e.g. preparation of glasses and glass ceramics and their characterization using differential thermal analyzer, X-ray diffractometer, and scanning electron microscope. The department is also having strong collaboration with Department of Electronics for development of LTCC materials for antenna and sensor application.

During the initial period of establishment of Department of Glass Technology and Silicate Technology the Department was having strong linkage with Indian glass industries which continued with Professor Prabhu Nath. This linkage was rejuvenated with the visit of executives of The All India Glass Manufacturing Federation (AIGMF) to the Department during 2011.

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GLASS NEWS WORLDWIDE

Hitachi develops near-indestructible glass storage chip

Hitachi has unveiled a new method of storing digital information on slivers of quartz glass that can endure extreme temperatures and hostile conditions without degrading, almost forever.

"The volume of data being created every day is exploding, but in terms of keeping it for later generations, we haven't necessarily improved since the days we inscribed things on stones," Hitachi researcher Kazuyoshi Torii was quoted as saying.

He said the life of digital media currently available — CDs and hard drives — is limited to a few decades or a century at most.

Hitachi's new technology stores data in binary form by creating dots inside a thin sheet of quartz glass that can be read with an ordinary optical microscope.

The chip is resistant to many chemicals and unaffected by radio waves, and can be exposed directly to high temperature flames and heated to 1,000 degrees Celsius for at least two hours without being damaged.

It is also waterproof, meaning it could survive natural calamities, such as fires and tsunami.

Hitachi's prototype device is just a 2 centimeter square with just 2 millimeter thickness and has a storage space of about 40 megabytes per square inch, putting the current prototype around the same space as a regular CD. Hitachi says that since the information is stored as dots in layers, adding more layers should not be a problem. This way, they will hopefully increase storage space without increasing the length and breadth of the glass itself.

Europe adopts End of Waste criteria for glass

End of Waste (EoW) criteria for glass have been adopted by the European Commission (EC) in a move which has been welcomed by the glass industry.

The criteria appear to say that for EoW to be achieved, the glass cullet must be of a quality suitable for re-melting into bottles or other products such as glass fibre. EoW criteria specify when certain waste ceases to be waste and obtain the status of a product or a secondary raw material.

The criteria were drawn up by the EC's Joint Research Centre (JRC) - the European Union's (EU) scientific and technical research laboratory - and state that glass cullet must comply with a customer specification, an industry specification or a standard for direct use in the production of glass substances or objects by re-melting in glass manufacturing facilities. The criteria place limits on the amount of contaminants such as metals, organics and stones which can be contained in glass cullet in order for it to be classed as a secondary raw material.

According to the JRC, it is estimated that more than 80% of glass collected across Europe will meet EoW criteria after proper sorting and treatment, to be re-melted into newly manufactured glass products.

A New Float Glass is Released

Recently, a high-tech glass product with the function of filtering, energy conservation and emission reduction has been released, and this kind of glass is characterized by reducing cooling load, especially reducing the thermal effect of ultraviolet rays and near infrared rays from the Sun.

This glass product was researched and developed independently by Xiangtan Kaisheng New Materials Technology Co., Ltd. It can absorb rays selectively from the Sun and filter over 90% of the harmful ultraviolet

rays and near infrared rays, which makes over 70% of the visible light through, so as to keep warm in winter and keep cool in summer; this new product can be used to the front windshield of automobiles and trains, and the windows and curtains of buildings.

The company successfully developed the UV-IR absorbent by the ultra heat-absorbing glass technology, in which the reversible principles in photochemistry and photophysics are applied and the compound of quencher and deactivator is used. If such UV-IR absorbent is added to the composition of unorganic glass and organic glass or various kinds of resin optical films with a proper proportion, the thermal insulation materials (paint) and the laser wave protective products of varied types that can absorb ultraviolet rays and near infrared rays can be made. Such glass can also be processed for various purposes, such as tempering, hot bending, laminating, bulletproof and heat insulation etc. In addition, it can also be used for protection from laser wave in the field of national defense for military purpose.

Facades the Top Theme at glasstec 2012

Large-format glass facades are a striking element of modern architecture all over the world. They not only create maximum transparency but also assume diverse functions to guarantee the building's energy efficiency and utility convenience. From October 23-26, in Düsseldorf, at glasstec 2012, the leading trade fair for the international glass industry, the glass facades theme will therefore play a key role and be a key element in several special themes. The central contact point for all those involved with facades in a professional capacity is Hall 11. That is the location of the "facades center" with the "competence center glass, window, facade" and the "glass technology live" special show.

The "competence center glass, window, facade" concentrates the know-how of numerous institutes and associations, including EuroWindoor, the German Flat Glass Manufacturers' Association (Bundesverb and Flachglas - BF), also including various quality associations, the Association of Independent Facade Consultants (UnabhängigeBeraterfürFassadentechnik-UBF), the Institute for Window Technology (InstitutfürFenstertechnik Rosenheim - ift), the Bavarian Center for Applied Energy Rese arch(BayrischesZentrumfürangewandteEner gieforschung - ZAE) along with the German Sustainable Building Council (Deutsche GesellschaftfürNachhaltigesBauen - DGNB).

In turn, with its exhibits and presentations in space of 2,500 square meters, the neighbouring "glass technology live" special show is taking a look at the future of the material glass. The range of exhibits includes innovative facade elements, for example featuring building-integrated photovoltaic systems. The special show is being organized by Prof. Stefan Behling and his team from the Institute for Architecture and Urban Planning at the University of Stuttgart under the motto "Innovative Glass Functions". On October 25, in the supporting symposium with free admission to all trade fair visitors, the theme will be "Integrative concepts for transparent building shells".

In addition to the ranges covering all aspects of glass facades in the exhibition halls at glasstec, two supporting conferences will also be looking at the theme. On October 24, under the motto "Appearances + Perspectives", the "architectural congress" organized by the North Rhine-Westphalian Chamber of Architects (Architektenkammer Nordrhein-Westfalen) and Delft University of Applied Science (Technische Universität Delft) along with Ostwestfalen-Lippe University of Applied Sciences (HochschuleOstwestfalen-Lippe) will be directed at architects, structural engineers, air-conditioning technicians and facade planners. Sustainability and aesthetics are the key theme areas.

On October 25 & 26, the "engineered transparency" scientific specialist conference organized by the TU Dresden and TU Darmstadt Universities of Applied Sciences will be directed at experts from the areas of research and development as well as construction and design. They will be examining the latest developments and research results in relation to engineered (glass) transparency along with innovations in the areas of facade technology and solar energy in building shells. Both conferences will be held at the Congress Center East (CCD Ost) at the Düsseldorf Exhibition Center.

ENVIRONMENT

Delhi slaps blanket ban on plastic bags

In a major environment-friendly initiative, the Delhi government has decided to impose a blanket ban on manufacture, sale, storage and use of plastic bags in the national capital.

The decision was taken at Cabinet meeting presided over by Chief Minister Sheila Dikshit.

Green groups have been demanding a blanket ban on plastic bags in the capital for long.

Following a Delhi High Court order, the government had in January, 2009 imposed a ban on the use of plastic bags in various markets, shopping malls, hotels and hospitals but it has not produced desired results.

Delhi Government has now decided to impose the ban as per provision of the Environment (Protection) Act, 1986 under which the violators could face imprisonment up to five years and fine of upto Rs 1 lakh or both.

"The Cabinet has decided to impose a ban on manufacture, sale, storage and usage of plastic bags in Delhi considering its adverse impact on the environment and ecology," Dikshit, known for her environment-friendly initiatives, said.

She said plastic bags have been causing blockage of sewerage network in the city resulting in serious public health-related problems.

Officials said Cabinet took the decision as the existing ban on plastic bags, which did not include manufacturing activities, has not produced desired results.

Plastic carry bags for use, as specified under the Bio-Medical Waste (Management and Handling) Rules, 1998 will not be covered under the ban.

Officials said authorities like civic bodies, NDMC and Environment Department will implement the decision.

"No person shall (be allowed) to manufacture, store, import, sell or transport any kind of plastic carry bags (including that of Poly Propelene, Non-woven fabric type carry bags) in the whole of National Capital Territory of Delhi except for export purposes," an official said.

Currently, around 400 plastic bag manufacturing units are operating in the city and the total yearly turnover of these units is in the range of Rs 800 crore to Rs 1,000 crore, an industry expert said.

The Delhi Pollution Control Committee member-secretary will ensure overall monitoring and implementation of the ban. The notification will come into force with effect from the date to be decided by the Government in the official Gazette.

O-I wins sustainability Gold

Glass manufacturer O-I has been commended by the NSW Government for its outstanding productivity and efficiency savings made through the Sustainability Advantage Program.

O-I was recognised with the Sustainability Advantage Gold Partner status at a ceremony at the Museum of Contemporary Art , along with TAFE NSW Northern Sydney Institute. In addition, 11 Silver and 21 Bronze Partners were also recognised.

"O-I Sydney has reduced its energy use by 25%, saving $3 million annually, and manages to keep 80,000 tonnes of waste glass out of landfill each year," said NSW Environment Minister Robyn Parker.

"It also betters world's best practices for water use in glass manufacture and recently invested $20 million in plant upgrades and new recycling infrastructure, creating 10 new jobs," Parker said.

O-I Australia General Manager Brian Slingsby said the Sustainability Advantage Program had helped the

company decrease water and energy use, reduce emissions and increase its use of recycled glass.

"Statewide, 630 organisations are saving $97 million through the program; their savings include more than 157,000 megawatt hours of electricity, almost 793,000 gigajoules of gas, 5400 megalitres of water and more than 120,000 tonnes of waste a year," Parker said.

"Achievements like these show that the NSW Government is helping business to be more resilient and profitable, while benefiting our environment."

More than 86% of the funding available through AusIndustry Clean Technology Investment Grants has been claimed. There are 630 organisations participating in the Sustainability Advantage Program. Of these, 120 have achieved Bronze, Silver or Gold Partner status.

Welcomes its New Members

(July-September 2012)

S. No.	Company Name and Address	Product/Services
1.	Mr. Jay K. Pater **Bisazza India Pvt. Ltd.,** Survey No. 372/2, Nr. Gail & GIDC Office Village : Budasan, Kadi-382715, North Gujarat T : +91 2674 242309, E : jay.patel@bisazza.com	Glass Mosaic
2.	Mr. Sanjay BK Industry Sector, Industrial Automation **Siemens Ltd.** I IA VSS PA - GLASS & SOLAR Thane Belapur Road, Thane-400601, Maharashtra, India T : +91 22 3326 5848, E : sanjay.bk@siemens.com	Glass Industry – Solution Provider

Membership of AIGMF

Membership

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

The 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.:

- Western India Glass Manufacturers' Association
- Eastern India Glass Manufacturers' Association
- U.P. Glass Manufacturers' Syndicate
- Northern India Glass Manufacturers' Association and
- South India Glass Manufacturers' Association

Admission Fee / Annual Subscription Affiliate Members:

The admission fee and annual subscription is ₹ 2,000/- and ₹ 5,400/- respectively.

Applicants for enrollment for a period of five years may pay a consolidated amount of ₹ 27,000/- (including admission fee).

Affiliate members from Countries other than India

i. The admission fee and annual subscription is US $ 100/- and US $ 200/- respectively.

ii. Applicants for enrollment for a period of five years may pay a consolidated amount of US $ 1000/- (including admission fee).

Ordinary Members:

Admission fee ₹ 550/-.

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ii. More than one Unit: ₹ 50,000/-

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ENERGY SAVING TECHNOLOGIES IN GLASS INDUSTRIES

Energy costs have been rising continuously for more than two decades. This is due to rise in crude oil price from USD 27 per barrel, to more than USD 100 per barrel. Fuel being a major input in glass manufacturing it is very important to look at the possible measures that can be taken to reduce this ever increasing burden.

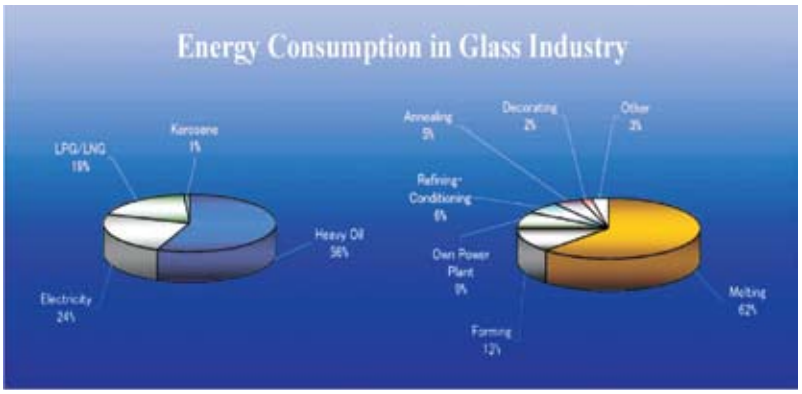


Fig. 1: Left figure represent ratio in the energy source and right energy consumption in each production process

To be more effective in controlling the fuel cost let us understand where the energy is being consumed in the manufacturing process. Figure 1 shows the distribution of energy being consumed in the process. Since 62% of the energy is being consumed in the melting process it is imperative that the maximum potential for energy saving lies in Melting process.

Inspection of a fluorescent light manufacturing company in Vietnam gave an energy balance chart as shown in the Fig. 2.

To control the energy inputs we have to analyze the following stages of Melting process.

1. Design
2. Operation

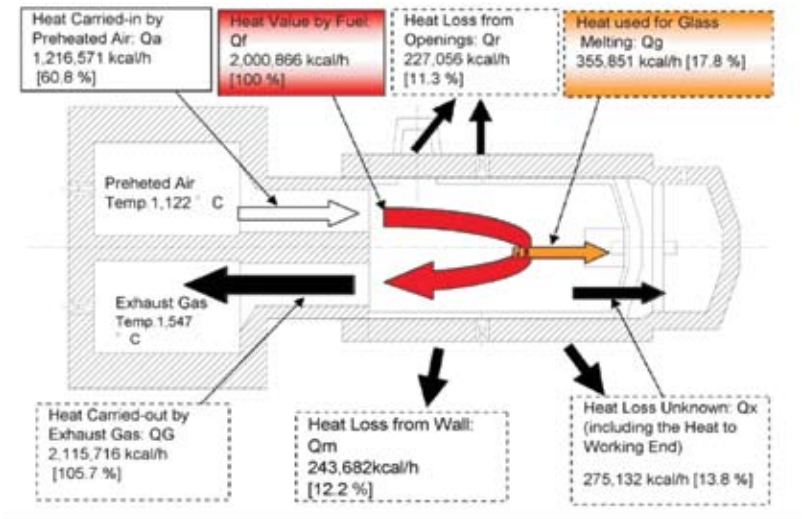


Fig. 2: Energy balance

DESIGN

Points that need to be considered for energy saving in designing are:

1. Appropriate furnace size for required capacity
2. No invasion of unnecessary air
3. Good thermal insulation and cooling
4. Improvement in exhaust heat recovery

Appropriate furnace size for required capacity

To decide the size of an appropriate glass furnace, the relationship between the melting rate (tons/M^2.day) and the pull rate (tons/day) is important.

The furnace smaller than the required size effect the decrease in the quality of the product, and the furnace larger than the required size effect to grow the heat emission from the surface and worsen the energy efficiency.

For example 50 people moving in a bus is more efficient than moving with 10 small cars. However if 5 people

move in a bus using a bus is more inefficient than moving in a small car.

In the language of a glass furnace

25 MT per day furnace : 1.5 MT per M^2 (16.7m^2)

150 MT per day furnace : 2.5 MT per M^2 (60.0 m^2)

No invasion of unnecessary air

Intercepting unnecessary air prevent cold air invasion inside the furnace and heat emission leakage.

For example, calculation of heat loss when the extra hole of 150x150 is opened is shown below:

The losses by radiation are 0.4 liters an hour when thinking by the heavy oil.

On the other hand losses by invasion air are 11.1 liters an hour, because of the air 220M^3 will invade in the furnace when furnace temp is high and furnace pressure of -9.8 Pa

For saving energy no invasion of cold air is very effective (See Fig 3.)

Good thermal insulation and cooling

Here it is written cooling which contradicts energy conservation.

The figure below is an example of improving tank block insulation. The left figure show the arrangement using the general insulation. In the right figure the addition of a layer of Insulating

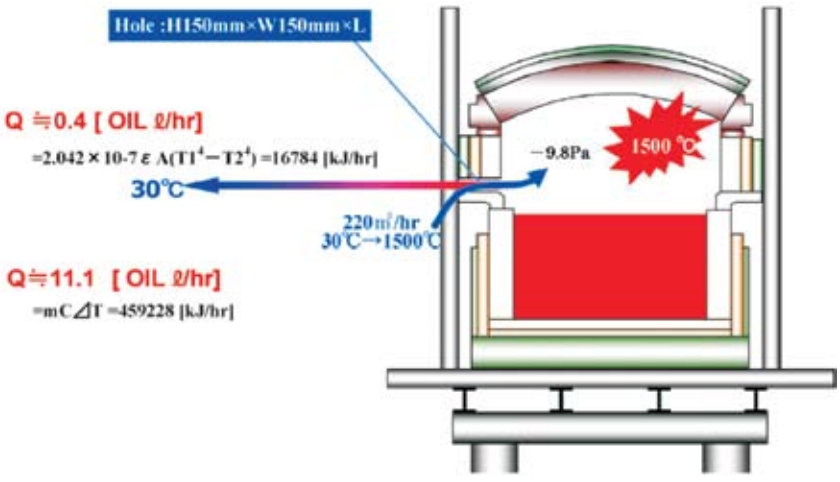


Fig. 3: For energy saving no invasion of cold air is very effective

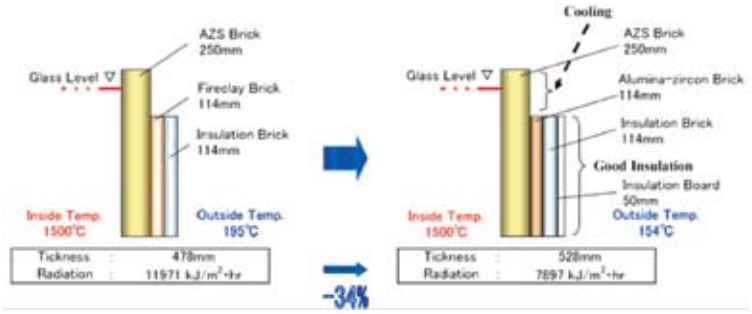


Fig. 4

board in the outer layer strengthens the insulation to the extent of radiation loss by as much as 34% see Fig. 4.

It is necessary not to have insulation glass line because erosion of the brick becomes much faster and it is necessary to provide controlled cooling around that area.

At IFC while designing a furnace, insulation selection is done based on the calculations done with the help of special software as shown in Fig. 5.

Improvement in exhaust heat recovery

Thermal efficiency can be improved by two methods in heat recovery equipment.

- Increase gas velocity which brings about
  - Increase pressure drop
  - Increase Clinker
- Enlarge heat transfer area which brings about
  - Expand system volume
  - Increase cost

To improve waste heat recovery an appropriate balance of shape, size, material and installation is very important.

At IFC while designing a furnace, following indexes are calculated first, and choose the best value that collated with calculated results and the past Data.

I1 = Checker surface (M^2)/ Melter Glass surface (M^2)

I2 = Whole checker volume (M^3)/Melter glass surface (M^2)

I3 = Pull (t/day)/ Whole checker volume (M^3)

I4 = Gas velocity (Nm/sec)

Furnace operation

1. Proper Fuel Air ratio
2. Proper Furnace pressure
3. Appropriate burner system
4. Appropriate Batch charger
5. Good control of glass level

The above 5 points are important requirement to operate a furnace for energy saving. In order to manage them precisely, a use of automatic control system leads to more energy saving.

Below is an example that explains an outline of automatic operating system for glass furnace. Each Number 1-5 show where the five requirements can be applied to a system (Fig.6) is an example that explains an outline of automatic operating system for glass furnace. Each number 1 to 5 shows where the five requirements can be applied to its system.

Proper fuel air ratio

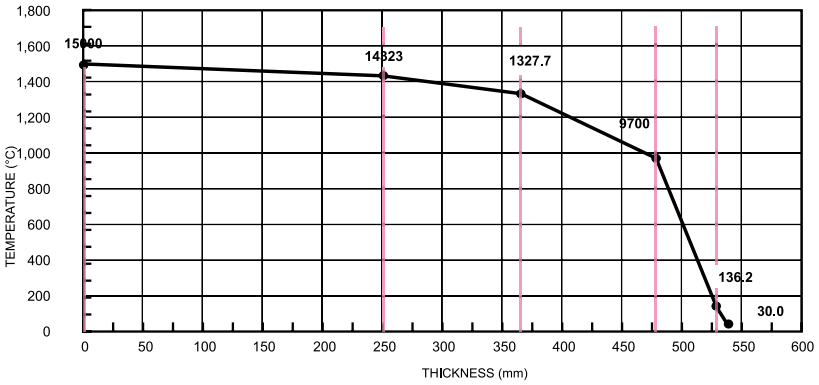
Below is an example of the control equipment which controls combustion air flow and oil flow.

This system feeds back an actual flow rate to preset flow rate on the control panel. Reflecting the results, flow control valves are triggered by the system.

This control instrument is programmed to blow combustion air in accordance with the oil flow volume. In order to keep efficient combustion state, air fuel ratio which is marked with a point at the intersection of red line with blue line must be maintained (Fig.7).

Customer : Project :			May 22, 2012 IHARA FURNANCE CO. LTD.
INPUT			
1	SHAPE	1	PLATE (1: PLATE 2-ARCH 3: PIPE)
2	RADIUS		mm (ARCH & PIPE only)
3	SPAN		mm (ARCH only)
4	DIRECTION	1	VERTICLE (1: VERTICLE 2: HORIZONTAL 3: CROWN 4: BOTTOM)
5	TEMP. of WALL (INSIDE)	1,500.0	^{0}C
6	OUTSIDE AIR TEMP.	30.0	^{0}C
7	BLACKNESS of WALL	0-80	<1.00
8	WIND SPEED		M/SEC
CONVERGENCE CONDITION			
1	MARGIN OF ERROR	0.01	^{0}CIcl T
2	MARGIN of ERROR (CONVECTION/CONDUCTION)	0.10 0.418605	<kcal/M2 hr <KJ/M2-hr

N_1	MATERIAL	THICKNESS mm	TEMP ^{0}C	THERMAL CONDUCTIVITY			MAXIMUM OPERATING
				Kcal/m hr ^{0}C	KJ/m hr ^{0}C	W/...K	
1	ZB-1581	250.0	1,500.0	5.530	23.149	6.430	1.800
2	AZ-GS	114.0	1,432.3	1.631	6.829	1.897	1.690
3	B-7	114.0	1,327.7	0.477	1.998	0.555	1.500
4	INSULATION BOARD	50.0	970.0	0.090	0.375	0.104	1.000
5							
6							
7							
8							
9							
10							
THICKNESS of WALL		528.0 mm					
HEAT DISSIPATION		1,497.5 kcal/hr M^2		6,268.6 KJ/hr m^2		1.7 kw/m^2	
SURFACE TEMP. of WALL		135.2 ^{0}C					



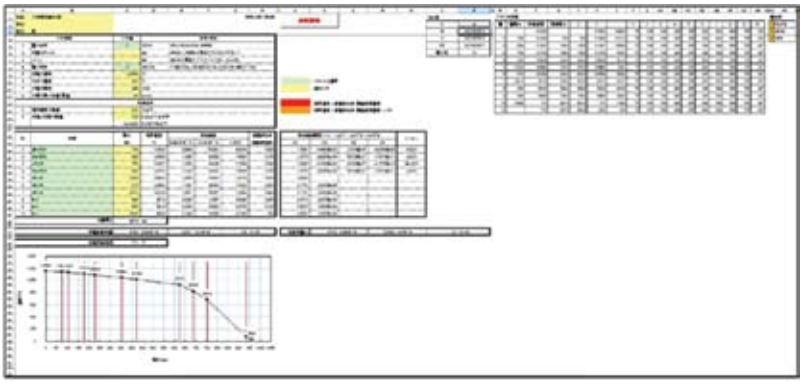


Fig. 5 : Selecting the best insulation by using the soft ware

Proper furnace pressure

Negative pressure in a furnace dramatically lowers the thermal efficiency due to unwanted air in flow. Excessive positive pressure in a furnace also damages furnace super structure, as well as slightly lowers thermal efficiency due to decrease of exhaust gas carried to a regenerator. In order to prevent these problems, pressure in the furnace must be set up between +0 and 5Pa.

Below is an example of pressure control in a furnace. This system feeds back an actual pressure to a preset pressure on the control panel. A pressure control damper is triggered by the system based on the results (Fig. 8).

Appropriate burner system

Appropriate burner system applied to furnace equipment must be selected.

Constant maintenance of such burners must be performed.

In the diagram below is indicated, keeping burner flame covering 70 to 90 % of the melting end length is thought to be the best flame coverage. Burners must be designed in such a way that it eliminates the tertiary air flow through the gap between burner and burner tile (Fig. 9)

Appropriate batch charger

In order to increase the energy efficiency, batch must be charged broadly, also deposited in the form of smaller mounds and additionally carried further to the back of M/E.

Bach charger must be selected by considering the size and the shape of furnace and the position of the dog house.

Good control of glass level

Glass level controller keeps the glass level stable, which helps improve the yield ratio of glass production. As a result of it, good level control leads to energy saving.

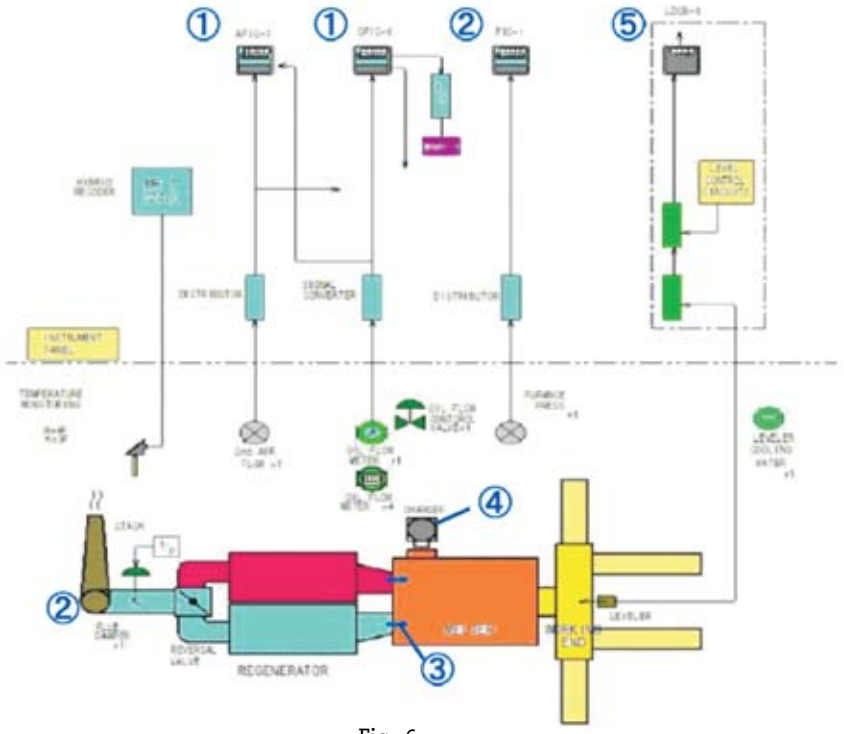


Fig. 6

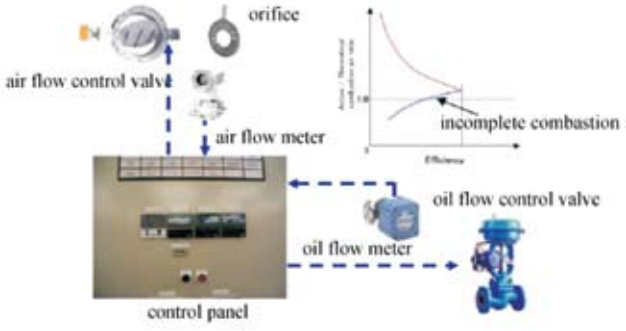


Fig. 7: Air fuel control

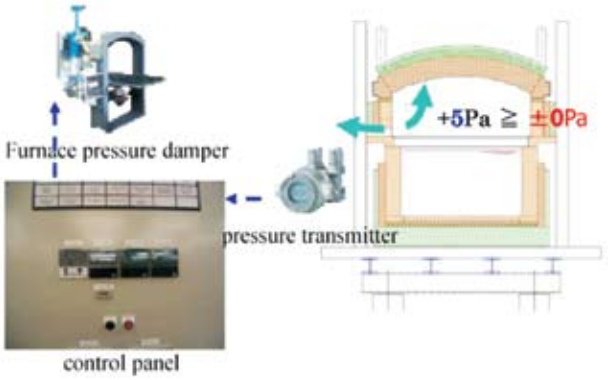


Fig. 8: Furnace pressure system

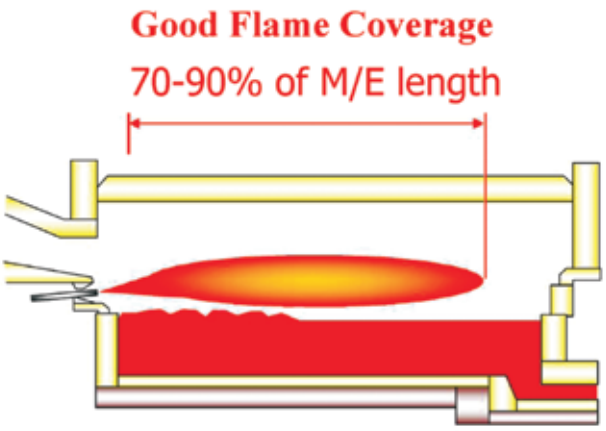


Fig. 9

Conclusion

A proper furnace design with the right equipments and care in the operations can make major difference in the fuel efficiency leading to better productivity and higher profits.

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10TH EDITION OF GREEN BUILDING CONGRESS 2012 TO BE HELD IN HYDERABAD, INDIA

10th Edition
Green Building Congress 2012
India's Flagship Event on Green Buildings
International Conference & Exhibition on Green Buildings
30 Oct - 1 Nov 2012
HICC, Hyderabad, India
Asia's Largest Green Building Conference & Exhibition

Introduction

The construction industry is one of the largest economic activities contributing to India's development. India has been witnessing tremendous growth in building and construction sector for the past 5 years.

With the increase in income levels, there are also changes in the life styles of various sections of the society. While this is a healthy trend, it is putting enormous pressure on the resource demand - like energy, water, materials, etc. The stakeholders of the industry have a vital role to play in preserving the environment.

In this regard, green buildings can play a catalytic role in addressing environmental issues and concerns.

"A green building is one which uses less water, improves energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building."

Spearheading the green building movement in India is Indian Green Building Council (IGBC) of the Confederation of Indian Industry (CII). The vision of the Council is to enable sustainable built environment for all and facilitate India to be one of the global leaders in sustainable built environment by 2025.

Green Building Movement in India

Green Building movement in India was triggered off when CII-Sohrabji Godrej Green Business Centre building in Hyderabad was awarded with the first and the prestigious Platinum rated green building rating in India. Since then Green Building movement in India has gained tremendous impetus over the years.

CII-Sohrabji Godrej Green Business Centre, Hyderabad, India's First Platinum Rated Green Building

With a modest beginning of 20,000 sq. ft. green built-up area in the country in the year 2003, today (*As on October 2012*) more than 1,765 registered Green Buildings Projects with a built-up area of over 1.24 Billion sq. ft are registered with the Indian Green Building Council (IGBC), out of which 283 Green Building projects are certified and fully functional in India.

Green Building Congress

IGBC as part of the out-reach programme organises Green Building Congress- Asia's largest Green Building Conference & Exhibition on Green Buildings. The flagship event on green buildings in India is held in different cities every year with an aim to educate, inform, network and unite all the stakeholders to spearhead the green building movement in India.

The earlier 9 editions of Green Building Congress was well received by all the stakeholders and the 10th edition of Green Building Congress 2012 is slated to be held on 30 October - 1 November 2012 at Hyderabad.

Government of Andhra Pradesh is the Partner State for Green Building Congress 2012.

Green Building Congress 2012 will focus on the following

- Architectural perspectives in green buildings
- National & International experiences in green building concepts
- Green Building Movement – Global & National trends
- Case studies on green buildings – National & International
- Green building rating systems
- Green building materials, equipments & technologies
- Public Policies

Benefits to the participants:

- Awareness on latest trends on green buildings
- Opportunity to network with National and International experts
- Platform to launch new green building products
- Awareness on green building rating systems
- Platform to develop new business opportunities

For more on Green Building Congress 2012, please visit:

http://www.greenbuildingcongress.com/site/gbc/index.jsp

or contact:

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The event would be marked by the following events

Event	Date
International Conference on Green Buildings	30th - 31st Oct 2012
Exhibition on Green Buildings	30th Oct -1st Nov 2012
Conference on Green Homes	1st November 2012
Conference on Green Cities	1st November 2012
Advanced Training Programme on Green Building Rating Systems - LEED 2011 for India	2nd - 3rd Nov 2012
Green Building Mission	2nd Nov 2012

Glimpses of Green Building Congress 2011

Government of Andhra Pradesh

Confederation of Indian Industry

Indian Green Building Council
Greening India since 2001

10th Edition

Green Building Congress 2012

India's Flagship Event on Green Buildings

International Conference & Exhibition on Green Buildings

30 Oct - 1 Nov 2012
HICC, Hyderabad, India

Asia's Largest Green Building Conference & Exhibition

EXHIBITION ENTRY FREE 30 Oct - 1 Nov 2012

Event Schedule

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Exhibition	30 Oct - 1 Nov 2012
Conference on Green Homes	1 Nov 2012
Conference on Green Cities	1 Nov 2012
Advanced Training Programme	2 - 3 Nov 2012
Green Building Mission	2 Nov 2012

Who Should Attend

- Architects
- Builders & Developers
- Corporate representatives
- Contractors
- Educational institutions
- Engineers
- Energy modellers
- Electrical consultants
- Green building facilitators
- Government representatives
- Green product / Equipment manufacturers
- HVAC consultants
- Interior designers
- International agencies
- Landscape consultants
- Lighting consultants
- Plumbing consultants
- Project management consultants
- Town planners

Benefits to Participants

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AIGMF
THE ALL INDIA GLASS MANUFACTURES' FEDERATION
www.aigmf.com

The All India Glass Manufactures' Federation (AIGMF) was one of the key supporting associations in Green Building Congress 2011. We thank AIGMF for agreeing to participate in Green Building Congress 2012 as of the key supporting association.

Date: 30 Oct - 1 Nov 2012
Venue: HICC, Hyderabad

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BOOM TIME IN THE WEST

Gujarat glass markets and makers face exciting future

Asian Glass magazine (www.asianglass.com) looks at how Gujarat's headline grabbing growth story has extended into the glass industry.

"Glass majors have made or announced massive investments in adding furnace capacity in Gujarat in recent years."

While there is much hype said to be vibrating the Gujarat growth story, it is undeniably one of India's industrial powerhouses, with most if not all the ingredients required to emerge as a 'glass hub' just like it has in ceramics. From raw materials to consumers of finished products in a variety of sectors, the state has what's required to draw investments from glass manufacturers, big and small. Demand for all four main types of commercial glass production - flat glass, container glass, fibre glass, and speciality glass - is set to increase in Gujarat given the massive industrialisation and urbanisation underway in the state.

The state has judiciously exploited its rich natural resources, such as minerals and oil and gas, as well as its maritime advantages. The discovery of oil and gas in Gujarat in the 1960s has led to the emergence of huge petrochemical complexes.

The state in western India, especially near Bharuch, Surat, is one of three identifiable concentrations of glass production in the country, where manufacturing has evolved from being a cottage industry to an organized industry, the others being West Bengal in the east and Firozabad, in Uttar Pradesh in the north of the subcontinent.

Gujarat is now known as the hub of India's pharmaceutical industry with over 5,400 manufacturing licenses, presenting a ready, accessible market for container and specialty glass. It is an emerging automobile manufacturing hub given investments and plans by auto majors to manufacture vehicles there. Ambitious urban development projects means demand for architectural glass and the similarly ambitious, massive solar energy programmes will also drive demand for glass.

Gujarat has a well-developed port infrastructure, is developing rail, road and telecommunications infrastructure and is considered a preferred investment destination in India, regarded as 'investor friendly' with reduced red tape. By exercising financial discipline and rationalizing the tax structure, Gujarat is a revenue plus state known for healthy economic management,

a favourable economic structure, and strong power sector performance. The state accounts for 30% of India's stock market capitalization.

According to the Industries Commissionerate of the Gujarat government, 83 industrial clusters for different industry groups have been identified in the state. It said cluster-based development has helped in improving cost competitiveness of the industries such as by creating common facilities and developing market centres. Glass is not among the existing industrial clusters identified in Gujarat.

But of 60 Special Economic Zones approved by the government of India at the end of 2011 one is for Ceramic & Glass in Jhagadia and Bharuch in an area of 170.7 hectares under the Gujarat Industrial Development Corporation (GIDC).

Cluster development

And there are incipient signs of glass manufacturing clusters emerging within the state, in areas with either access to key raw materials or natural gas, or both.

In Kosamba, Piramal Glass has one of its large container glass facilities while multinational pharmaceutical packaging manufacturer Gerresheimer AG has acquired a majority shareholding in India's Neutral Glass & Allied Industries which has a moulded glass plant there. In Jambusar, where good quality gas is easily available, Piramal Glass has its other facility while Schott Glass India has a glass tubes plant. Vadodara is the site of Hindusthan National Glass & Industries float glass plant under its associate firm HNG Float Glass Ltd. Other manufacturers with plants in Vadodara include Haldyn Glass, Alembic Glass, Goel Scientific Glass Works, Noble Glass Works and Shreno Ltd. Gujarat Alkalies and Chemicals Limited is major supplier of soda ash in India is situated in Vadodara. Bharuch, where again gas is available along with silica sand reserves, is home to Gujarat Borosil, Guardian Glass Industries, Videocon, Narmada Glass and Surya Udyog.

Mining clusters have flourished in Junagadh, Kutch, Bharuch, Vadodara and Mehsana districts. Mineral resources are important ingredients of the state economy which has access to vast deposits of bauxite, manganese ore, limestone, lignite and natural gas, enabling mineral-based industries to flourish. These include clay based ceramic units and silica sand based glass units along with limestone based cement and soda ash industry, lignite-based power plants, and bauxite-based alumina plants. The minerals sector accounts for 12.4 per cent of the total sales by industries in the state with processed minerals like silica sand, kaolin, chalk, fire clay, and bentonite consumed by glass, ceramic, plastic, paint and rubber manufacturers.

Over the years, Gujarat has diversified its industrial base substantially, having started industrialising in the 1960s with textiles. According to the Annual Survey of Industry, Gujarat accounts for 18% of fixed capital investment, 17.22% of gross output and 15.20% of net value added in industrial sector in India. The survey reinforces Gujarat's position as the most industrially developed state in India in respect of first ranking in industrial investment and second in terms of value of production and value addition in the industrial sector.

Gujarat Industrial Development Corporation has established industrial estates providing developed plots for investors. The state government also developed infrastructure facilities required for industries like power supply, roads, ports, water supply and technical education institutions and introduced incentive schemes to lure investors. Today 12 major industry groups together account for 86% of factories, 96% of fixed capital investment, 94% of value of output and 95% of value addition in the state's industrial economy. In the recent years, refined petroleum products has emerged as one of the largest industrial groups having 33% share, followed by chemicals having 21% share. Other important groups include agro and food products (8.5%) and non-metallic mineral based products (2.5%).

Enter the majors

Glass majors have made or announced massive investments in adding furnace capacity in Gujarat in recent years.

The Jambusar facility of Piramal Glass, which aims to be one of the top three global flaconnage glass companies, now has one of the world's largest installed capacities for pharmaceutical packaging in amber glass with three furnaces and 22 production lines. In April 2012 its capacity was further expanded with the addition of 160 tonnes per day, from 355 TPD to almost 520 TPD, making Piramal Glass the world's second largest Cosmetics & Perfumery company in terms of capacity with 550 TPD as total installed capacity. Piramal Glass is in fact the world's largest producer of nail polish bottles with a market share of more than 30% and

is shifting its production mix to focus on the high margin cosmetic and perfumery (C&P) segment. The revenue share of the C&P business of Piramal Glass has increased to about 49% in FY2011 from about 30% in FY05.

The firm enjoys a considerable cost advantage on its products vis-à-vis European competitors, with the total cost of production in India, where manpower is among the cheapest in the world, is around 60% of the global costs and less than half of that in France and almost half of that in the US. Labour costs account for over 50% of overall product costs in Europe for C&P manufacturing as against less than 10% of the manufacturing cost in India.

Hindusthan National Glass & Industries Ltd., (HNGIL), the largest producer of glass containers in India, has also announced a massive expansion plan for its new float glass plant at Halol with a second float line. It has a tie-up with the US-based Toledo Engineering Company. Halol is an industrial town 35 km from Vadodara. Actual investment and work on expanding the Halol float glass plant, which was originally scheduled for completion in 2013-14, will likely come only next year. Since the announcement was made, the rupee has depreciated against the dollar and interest rates have risen, increasing costs and squeezing profit margins. L N Mandhana, Chief Financial Officer of HNGIL, said no further investments will be made in expanding float glass capacity at Halol this year and that firm plans for adding capacity will be known only next year. Through the acquisition of a 47.5% stake in HNG Float Glass, HNGIL entered the real estate and auto glass segments. HNG Float's plant is designed to make clear float glass, tinted float glass, reflective glass, low-e, low iron solar glass and automotive glass. HNG Float Glass has a production capacity of 600 tonnes per day at Halol. This will be increased to 1,600 tonnes per day, according to HNGIL managing director Mukul Somany, with the expansion billed as the world's largest 1,000 tonne per day furnace funded largely through debt. The company, which now has almost 20% market share of the float glass segment, is looking to make automotive glass at its Halol factory. It is in talks with foreign firms for technical and financial tie-ups with the aim of acquiring technology for the manufacture of automotive specific glasses. Given the Halol plant's central location, HNG Float Glass is focusing the Indian automotive industry in a big way. Many auto majors have production plants within reach, like the General Motors facility at Halol and Tata Motors' Nano car manufacturing unit in Sanand, near Ahmedabad. And another major automotive belt is located not far away in Pune. HNG Float Glass is also seeking mining rights for silica sand in Gujarat. HNGIL, already has a massive expansion underway elsewhere, setting up the largest integrated glass complex in the country with an investment of Rs 4,000 crore at Naidupet in Andhra Pradesh with five furnaces; three to manufacture glass containers and two to make float glass.

Multinational presence

Multinational glass manufacturers have also established a presence in Gujarat. Schott, the dominant player and largest supplier of pharmaceutical glass tubing in India, has two manufacturing units in Gujarat. Schott entered India in 1998 by taking over a company producing pharmaceutical tubing in Jambusar. According to the company, that plant now functions as a production hub for Schott pharmaceutical tubing for Asia. The other unit is Schott Kaisha, a joint venture formed in May 2008 when Schott AG took over Kaisha Manufacturing in Daman from the ShapoorjiPallonji group. With much of Schott's earnings growth coming from its Asian operations, the German MNC has said manufacturing capacities will be expanded in Vadodara in 2012.

Another German glass MNC Gerresheimer has also entered the Indian market by buying Indian pharma glass packaging manufacturer Neutral Glass & Allied Industries, which has a moulded glass plant in Kosamba. Having a plant in India is seen as strategically important for the German firm which seeks to exploit the rapid growth of pharma glass packaging in emerging markets. Neutral Glass has 600 employees, four furnaces and 12 IS lines, producing pharmaceutical primary packaging products such as glass vials for liquid medications and infusions, as well as injection bottles.

It was the growing auto manufacturing industry in Gujarat and a desire to get close to customers given the difficulty in transporting a fragile product like glass over long distances that prompted Saint-Gobain Glass India, the Indian unit of the French glass MNC, to acquire the float glass business of Sezal Glass based in Bharuch. The Sezal acquisition gave Saint-Gobain a foothold in the western part of India and access to northern markets and halved the distance its products travelled to reach customers. Before the acquisition, Sezal had announced plans to increase production to 1,250 tonnes a day by

2013 from 550 tonnes. The acquisition along with the greenfield float plant at Bhiwadi will result in Saint-Gobain Glass India's capacity increasing to 2,800 TPD or over half the total float industry capacity, making it the largest player with capacity twice that of its closest competitor, Asahi India Glass. With nearly 50% of its capacity equally split between the northern and southern regions, Saint-Gobain is well-positioned to increase market share, although the surplus supply situation and reduced demand after car sales slowed down has put pressure on domestic float glass prices.

Haldyn Glass Ltd., one of the smaller players in the container glass industry with a plant near Vadodara, aims to increase capacity to 380 tonnes a day during the last quarter of 2012 from a current 320 TPD in its two glass melting furnaces. Furnace capacity has been increased from 160 TPD in 2008. It is a joint venture with the Gujarat Industrial Investment Corporation. It supplies clear glass container products and vials to the liquor, pharmaceuticals and food and beverages industries. With over 85% of total sales derived from the liquor and brewery industry, Haldyn wants to diversify its customer base by increasing its share of customers in the food and beverage segment. The company expects the retail food sector in India to double by 2025 on account of a growing health consciousness resulting in the increased use of glass packaging. In India, only 10-12% of all food and beverages are packed in glass containers as against 40-50% in developed economics. Hence, demand for glass containers is expected to increase driven by growing consumer awareness about health and hygiene and eco friendly products. Haldyn plans to set-up bottle printing and decorating facilities to provide value added services to customers, particularly in the beverage and processed food processing business.

Market focus: SOLAR

Government policies to encourage solar energy, both the National Solar Mission and Gujarat's own state of solar policy, will drive demand float and low-iron clear glass in the region. The Gujarat Solar Policy target is 500 MW by 2014 and the state has attracted a host of investments in solar power production with investors drawn by incentives under both the national policy as well as the state policy. Gujarat Non-Conventional Energy Corporation supplies heating systems at a concessionary rate owing to which use of solar thermal systems in commercial buildings, hospitals and hotels has increased for cost effective water heating purpose. With increasing demand of solar thermal systems, demand of speciality glass has also increased in the state. Demand is also coming from increasing use of PV modules which typically contain two glass sheets as well as solar thermal systems with flat plate collectors, with each collector requiring two square metres of glass.

Market focus: PHARMA

The state of Gujarat contributes 35% to India's overall pharmaceuticals output, is home to 40% of contract research organizations in the country and accounts for 22% of India's pharma exports. Gujarat is known as the hub of the Indian pharmaceutical industry with over 5,400 manufacturing licenses which employs around 63 000 people in the state. There are more than 50 biotechnology companies with a combined annual turnover of around US$ 150 - 175 million. The rapid growth of India's pharmaceutical industry and medical electronic service industry, among the major speciality glass consumption industries, ensures continued demand for glass.

Gujarat's petro chemical hub also needs specialty glass the supply of which is now met mostly by imports. Specialty glass domestic and scientific applications include products like fibres, electrodes, radiation protection plates and heat resistant laboratory glassware as well as head lamps, TV tubes, health services and space equipments lenses and filters. The use of domestic speciality glass for ovens is also increasing rapidly in the country and has attracted the likes of Schott which sees Indians using more glass ceramic topped cooking appliances as incomes rise and modular kitchens grow in popularity. As imports become more costly with the rupee weakening, the company is considering manufacturing in the country. Other drivers for specialty glass demand are innovations in display technology that creates demand for lighter weight, wide and flat panel glass. In fact demand of display glass in the state is higher than in any other state in India as mobile users and flat panel consumption is higher in the state. The main raw materials for speciality glass like silica sand, soda ash, dolomite, quartz are available in the state.

Market focus: FLAT GLASS

Gujarat's major urban development projects will drive demand for architectural glass. Gujarat, which

accounts for 6% of the total geographical area of the country and around 5% of its population, is known as the 'urbanized state of India' with a 43% share of urban population as compared to 28% share of urban population in India as a whole. The state has plans to develop several twin cities on the lines of New York and New Jersey

Market focus: AUTO

Auto glass manufacturing is another sector with much potential. With auto majors like Tata Motors, Ford, General Motors, and Hyundai Heavy Industry having or building manufacturing plants in Gujarat, the state is seen becoming another auto hub of India, after the southern state of Tamil Nadu. French carmaker Peugeot is building a manufacturing facility at Sanand and Maruti Suzuki, India's biggest car manufacturer, is to establish a plant at Becharaji in Mehsana district, its third manufacturing facility in the country. The new unit, expected to be commissioned by 2015-16, would have an initial capacity to make 250,000 cars a year.

Market focus: RAW MATERIALS

The best fuel for glass melting furnaces, natural gas, is available in Gujarat in abundance, along with key raw materials like sand, soda ash, dolomite, limestone, sodium sulphate and quartz. In fact the state accounts for as much as 94% of the country's production of soda ash, which constitutes about 30-40% of cost of production of glass products. Soda ash is the single largest constituent in the entire batch of the raw materials used in glass manufacture. Large soda ash capacities are located on the west coast, mainly Saurashtra region of Gujarat, due to easy availability of salt and limestone - the key inputs for production of soda ash. Estimated soda ash production capacity is about 2.0 million TPA. All five of India's large soda ash producers are situated in Gujarat, including the largest manufacturer Tata Chemicals with 35% of installed capacity, followed by Gujarat Heavy Chemicals. Gujarat Alkalies and Chemicals Limited, another major supplier of soda ash, is situated in Vadodara.

Gujarat contributes 53% and 31% to Indian crude oil and natural gas production respectively and is the first state to have a gas grid. It has a 2,200 km integrated gas grid that is operated on an open access common carrier principle, ensuring steady supply to furnaces.

Manpower and logistics

Much of the skilled manpower required by glass industries such as efficient and experienced furnace operators and quality controllers to check the quality of raw material used in glass manufacturing is available in the state as it is already a ceramic manufacturing hub. A branch of the Central Glass and Ceramic Research Institute (CGCRI) was established at Ahmedabad as far back in 1977 and has played a key role in making the state a ceramic hub.

In terms of logistics, Gujarat has planned six investment regions and industrial nodes in the section of the dedicated freight corridor (DFC) logistics link between New Delhi and Mumbai. An area of 150 kms on both sides of the DFC will be developed as the Delhi Mumbai Industrial Corridor (DMIC), with 38% of the planned route running through Gujarat. The six investment regions are Dholera (Ahmedabad Investment Region), Vadodara (Ankleshwar Industrial Area), Palanpur (Mehsana Industrial Area), Bharuch (Dahej Investment Region), Surat (Hazira Industrial Area) and Valsad (Umergam Industrial Area).

FOLLOWING IN PANEL

Investment headaches

Not everything is perfectly satisfactory for investors in Gujarat. Behind the hype there are a host of shortcomings, according to studies done by consultants hired to develop special investment regions:

Overall perception of industries with respect to infrastructure - industrial as well as social - is 'below average'

Major problems and issues raised by industries -

- Public transportation facility connecting Dahej with Bharuch and Ankleshwar is very poor. Employees and workers have to predominantly depend on facilities provided by the company. Flexibility of public movement within the estate as well as outside estate during odd hours is very difficult not only for the employees but their family members as well.
- Overall social infrastructure within the region is highly under developed. There are not enough proper education, healthcare, hotel and restaurant and recreational facility options for the people of the region.

- Industries face power problems with respect to unscheduled cuts which affect the productivity especially in the continuous process plants. To make up for production loss industries have to operate diesel generator sets which eventually increase overall production costs.
- Industries face shortage of technical skilled manpower primarily because of establishment of large number of competing industries in the region. The nearest industrial technical institute (ITI) located in Ankleshwar could fail to meet the growing need of skilled manpower in the years to come.
- GIDC has not laid down complete water distribution systems in some industrial estates and some industries procure water through tanker or via other industries. This increases the delivered price of water by significant amount
- Although overall road infra in the region is excellent, approach roads to some of the industries have not been developed. This problem is primarily faced by industries which are not part of GIDC developed estates/SEZs and are scattered across the region
- Land prices have increased steeply over the past year in anticipation of growing need of land for the development of industries. Such sustainable rise in prices could dampen overall rate of industrialisation in the years to come.

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COMPETITION LAW ENSURES ECONOMIC GROWTH IF ENFORCED PROPERLY

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Background

Competition Law ensures free and fair competition amongst business enterprises. Business enterprises operate in horizontal as well as vertical relationships with each other. No business enterprise can function without being dependent on others. The dependence, between and amongst businesses, is legally achieved through the instrumentalities of agreements, arrangements, understandings or meeting of minds. Therefore, agreements between business houses form the core ingredient to assess and understand as to how different segments of business enterprises operate to achieve targets/objectivities of doing business.

Agreements, arrangements were not very serious issues of doing business in India till 20 May 2009. Government of India by a Notification in the Official Gazette under the Competition Act, 2002 (as amended up to 2009, the Act) made certain substantive provisions of the Act enforceable on 20 May, 2009 which opened up a new era of challenge in India's trade and business world.

Business agreements which fall foul of certain provisions of the Act are considered void. Any business enterprise if found in contravention of any of such provisions of the Act, may face a fine to the tune of up to 10% of average annual turnover of preceding three financial years from the date of passing of the Order by an authority constituted under the Act – called *the Competition Commission of India* (the CCI). Additionally, the CCI may also impose a penalty for any proven charge of cartel or bid rigging to the tune of up to three times the profit earned or up to 10% of turnover of the period during which the cartel or bid-rigging continued. The CCI has been conferred with enormous statutory powers by the legislation to gather direct and indirect evidences against allegations of anti-competitive agreements which any business enterprise may have entered into either unknowingly or intentionally. The law further provides statutory powers to the CCI and the Director General (DG), the investigating wing, to carry out unannounced raids in the premises of any company and cause search and seizure of incriminating documents to substantiate any allegation of breach of the law.

Intent and purpose of the act

The Act though came into being on January 13, 2003 yet was not able to be made fully functional till June 1, 2011. It was made functional in three major phases. The first phase commenced on 14 October, 2003 when several sections of the Act were notified. The CCI was made partially functional. The second and third phases

respectively started from May 20, 2009 and June 1, 2011 when all the substantive provisions of the Act were notified. The Act is currently fully enforceable. The Act being a mix of micro-economics and law, public awareness of the law is one of the important legal provisions which the CCI is mandated to fulfil. The CCI, in the past as well as now, from time to time, organizes outreach programmes for various stakeholders of the Act. The cities of Delhi and Mumbai seemed preferred destinations for such programmes as the stakeholders of these two cities seem pro-active towards this new law and have been re-positioning their business objectives realigned with the new law. The Preamble of the Act says –

"An Act to provide, keeping in view of the economic development of the country, for the establishment of a Commission to prevent practices having adverse effect on competition, to promote and sustain competition in markets, to protect the interests of consumers and to ensure freedom of trade carried on by other participants in markets, in India, and for matters connected therewith or incidental thereto."

Key take-away from the Preamble:

- Economic development of the country to continue
- Establishment of a Commission with an aim
  - To prevent practices having adverse effect on trade-related competition
  - To promote & sustain competition in markets
  - To protect consumer interests
  - To ensure freedom of trade

Steps to achieve the objective of the Act

- Sustained competition advocacy both by the CCI and the stakeholders
- The CCI may pro-actively interact with government departments including State and Central PSUs highlighting the need for change in commercial and business policies so as to ensure level-playing fields between government and private companies
- National-level Industry Associations may play a crucial role to make their regional and smaller units aware of the challenges and opportunities of the law so that historical methods of doing business in India may gradually pave the way for compliance with the law
- Large business enterprises who have over the years achieved market leadership by efficient business methods may take leadership in this mission and review all the business processes in such a manner so as to ensure elimination of anti-competitive conduct while doing business
- Professional micro-economists, chartered accountants, cost accountants, lawyers, business managers, financial analysts and IT experts may work in tandem within an organization to help it achieve the in-house toolkit which will ensure full compliance with the provisions of the law without defeating the purpose of doing business in India and elsewhere
- Review of the toolkit periodically and special review to be carried out as and when new policy is announced by the Government and/or judgments pronounced by economic regulators including the CCI and the High Courts and the Supreme Court of India

CCI and MRTP Commission

MRTP Act frowned upon size of an enterprise in excess of 25% market share. But the Competition Act (the Act) does not do so. Size of an enterprise is not frowned upon but the conduct of a dominant enterprise to abuse its position of dominance to the detriment of competitors and other players in the market in India is prohibited. The MRTP Act did not have enabling provision to impose penal fines against a proven breach of the law whereas the Act has enormous powers conferred upon the CCI to impose huge penal fines upon delinquent enterprises. CCI has so far imposed huge fines against cement companies, LPG cylinder manufacturers, explosive manufacturers, phosphate tablet manufacturers, Real Estate Company and so on. Many matters are reportedly pending finalization and are likely to add to the list of imposition of huge fines upon companies. The Act does not distinguish between government and private companies, however, we are yet to witness a single order of the CCI against any PSUs even though several investigation reports have been completed by the DG and breaches of law were noticed in those reports against some PSUs.

The partisan attitude of the CCI has remained an enigma so far. May be due to the fact that majority of the Members and the Chairperson including were former bureaucrats and are reluctant to penalize government companies and corporations. Commercial anti-competitive activities of the any company – government or private – are within the ambit and scope of scrutiny under the Act as such illogical exoneration of any class of companies with unreasonable findings may affect the credibility of the CCI and resultantly force overseas companies to reconsider their plans of investing in India. This may, if not checked, derail the intent and purpose of the Act as well as economic liberalization policy of the Government of India.

Impact of overseas jurisprudence

The substantive provisions of the Act are nearly identical to provisions of competition laws of matured Common Law jurisdictions. As such the CCI, in the absence of precedents in India, may fall back upon some of the Common Law jurisprudence (judgments) and draw a strong persuasive value while deciding matters especially relating to MNCs who have been found in breach of competition laws at overseas jurisdictions more particularly in Common Law countries. We are aware that the CCI did rely upon many of such judgments in its various Orders. The CCI in terms of its statutory mandate to promote the law amongst stakeholders popularly known as 'competition advocacy' conducted market study of several industries of India. The selection of industry for such market study clearly indicates the intention of the CCI to go after certain specific sectors of industry which may perhaps face most challenges in overseas jurisdictions also. The CCI is a powerful member of the International Competition Network (ICN) and has been given important task to implement the law in such a manner so as to ensure convergence of the Act with other competition authorities. The ICN provides tremendous opportunities to younger competition authorities and the CCI is one of the few fortunate authorities to be Chair of a few committees of the ICN. This facility enables the CCI to update its domain knowledge and enforce the law in letter and spirit.

Conclusion

The Act takes within its ambit all the sectors of industry. The overlap, which may arise due to simultaneous functioning of the CCI and the sector regulators, would get resolved through cooperation and harmonization amongst sector regulators and the CCI. The High Courts of late has not been interfering with the statutory functioning of the specialized regulators and tribunals and this change has paved the way for better implementation of specialized law. We are, however, not ruling out the possibilities of judicial reviews by High Courts at times of blatant breach of the Constitution of India by specialized tribunals. Robust precedents may emerge from time to time by such interventions of the High Courts.

Free and fair competition ensures higher qualities of product and services at an affordable price. A better quality of product and services at competitive price raise the bar of consumer welfare. If the same is continued for over a period of time it would be very difficult to reverse such a wonderful socio-economic condition. Large section of the population would be refusing to go back to the past by relinquishing the benefits of socio-economic well being generated by competitive markets.

Ceramic welding: Part of furnace life-cycle management

Fred Aker discusses the ceramic welding capabilities of Fuse Tech International GmbH.

Holger Mayer, Managing Director of Fuse Tech International GmbH.

Fuse Tech International GmbH (FTI) is a relatively recent venture. The company was started in 2008 but its roots go back to 1993 in the USA. The original Fuse Tech Inc was created by Don Shamp and is in its second decade of serving the North American glass and coke oven industries.

Fuse Tech Inc (USA) and the Sorg Group are co-owners of FTI. This ceramic welding startup serves the glass industry worldwide outside North and Central America. Its Managing Directors are the Sorg Feuerungsbau specialists Holger Mayer and Werner Frankenberger.

CERAMIC WELDING GOALS

One goal is of a preventive nature. More and more customers are utilising cold face welding to hot seal furnaces. By sealing expansion joints, the furnace is gas-tight and subjected to less air ingress, leading to better efficiency, less NOx and more resistance to the onset of corrosion.

Another service provided by FTI is regenerator and port neck cleaning to restore efficiency and lower emissions on ageing regenerators.

The goal of most ceramic welding customers is to repair existing damage and to prolong the life of their furnace. This, of course, with little or no production losses.

While a minority of glass producers run periscope inspections at regular intervals, they remain the exception and not the rule. FTI is usually called when a customer is suffering from a specific problem. This could be a fallen arch, a broken tuckstone or other refractory damage.

FTI first visits the customer to inspect and assess the damage. The company makes a video of the periscope inspection to show the customer the extent of the existing damage. Then a course of action is recommended, which is discussed with the customer, along with all possible risks. The objective is to carry out a planned action; in this case, a minor refractory welding job before an emergency repair with the associated costs and downtime is necessary. After FTI and the customer agree on a course of action, a date is scheduled to carry out the actual welding.

To maintain a high degree of flexibility, FTI has 10 sets of equipment that it can despatch internationally to customers at short notice. For redundancy purposes, two sets are sent to each repair job. These modular sets consist of welding lances, a toolbox, a safety kit and a diamond chainsaw for cutting access holes for the welding work. Safety is of utmost importance. All equipment has been submitted to the German technical certification agency (TÜV) for inspection.

These 10 sets give FTI the flexibility to service five customers simultaneously. Crews usually consist of specialists from Sorg Feuerungsbau and Service GmbH. During peak periods, the company can bring in personnel with vast experience from Fusetech Inc in the USA.

Before the work can start, the equipment sets and dry welding materials are sent to the job site. FTI currently buys the welding mix from Fusetech Inc in the USA and stores enough for all contingencies in Germany. Discussions are taking place to see if it makes sense to mix the 'secret sauce' in Europe in the future.

Each job begins by repeating the water-cooled periscope inspection. This is to determine if the situation >

Cold face welding on a crown.

Welding lance.

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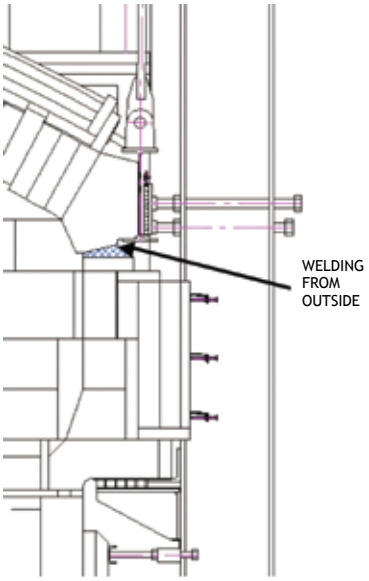

Welding from outside.


Welding being executed.

has deteriorated since the initial visit. Assuming there is no reason why the works cannot be executed safely, the job starts by cutting access holes for the welding lances. For this procedure, the water-cooled diamond saw is utilised.

Hot face welding with oxygen-enriched lances and the applicable patching materials takes place over a number of days. For especially difficult areas to access, the ceramic welding can be performed with the use of a camera and monitor to gain access to blind areas inside the furnace. After the work is finished, the periscope inspection is repeated to verify that the work was successful. Then the service holes are patched up from the outside, employing cold face welding. Often, a peephole is installed to monitor future developments.

All of this is performed under normal production conditions, with minimal effects on glass quality. A typical job duration is 10 days, with before and after inspections and documentation.


Welding via a monitor.


Transition brick port neck before ceramic welding.


Transition brick port neck after ceramic welding.

COLD FACE WELDING

Cold face welding can be employed for preventive measures such as hot sealing to close expansion joints on a new or rebuilt furnace. As demand for cold face welding increases, FTI has two additional sets of equipment dedicated to this purpose. Besides the company's central warehouse in Germany, these dedicated mini sets are located in Thailand and South Africa, with other international locations under consideration.

A second application for cold face welding is to repair damaged areas accessible from outside the furnace.

REGENERATOR TUNE-UPS

As customers strive for longer and longer campaigns, the importance of maintaining regenerators grows in importance. Old checker work makes for an inefficient glass melting system. Clogged, ageing regenerators lead to higher fuel consumption, higher emissions and greater CO_2 output. In this age of sustainability directives, this situation is unacceptable.

FTI has been a successful fit within the Sorg Group. International customers in all areas of glass manufacture are benefiting from the group's ability to handle the entire furnace life cycle. Its involvement goes from design through construction, installation and ongoing service. Now, FTI prolongs the life of customers' furnaces before another Sorg Group business executes the demolition and rebuild work. ■

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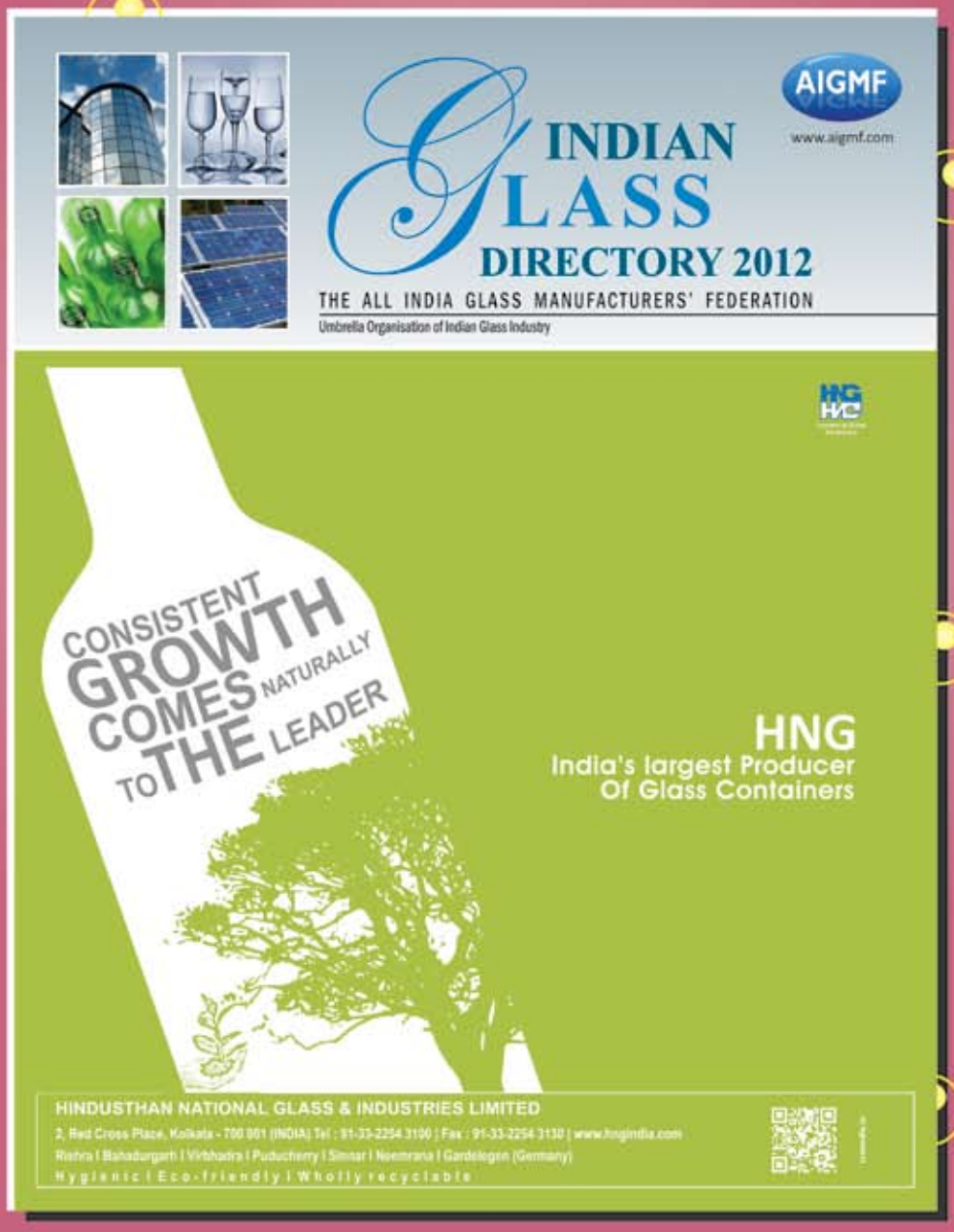

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