Vol. 2, No. 4, January - March, 2015

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REFRACTORY FOR GLASS INDUSTRY - GLASS TANK BOTTOM BLOCKS,

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GLASS TANK BOTTOM BLOCKS ARE DIAMOND MILLED ALL SIX FACES TO INSURE GLASS TIGHT JOINTS

ASTM/BIS GRADE INSULATING BRICKS

SHARAD - 23

SHARAD – 25

SHARAD -26

SHARAD - 28

SHARAD - 30

CHIMNEY BLOCKS FOR REGENERATORS FOR PETCOKE FIRING ALL GRADES HIGH FIRED

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TOP LOWER COURSES – ACL- 99SD

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

Vol. 2, No. 4, January - March, 2015

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From President's Desk

I am thankful to Messe Dusseldorf India Private Limited, a 100% subsidiary of Messe Dusseldorf GmbH-organizers of the world's leading glass exhibition "Glasstec Düsseldorf for the efforts put in by them to bring together companies from different parts of the world in GLASSPEX INDIA 2015.

I hope that GLASSPEX INDIA 2015 will receive good support from the industry in India and other parts of the world.

AIGMF is organising parallel conferences on flat and container glass with renowned speakers from India and abroad on March 13 & 14 who would be talking on 'Cost Effective Technology in Container Glass' and 'Use of Glass in Buildings wrt Regulations relating to Human Impact, Fire Safety & Energy'.

I am sure deliberations will enable delegates to understand global technological advancements in glass industry. GLASSPEX INDIA 2015 will also be a forum for glass fraternity to come together for closed interaction among themselves.

I extend warm greetings and felicitations to organizers and participants and best wishes for success of the event ■

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

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GLASS News India

AIGMF ASSURES PHARMA COMPANIES OF UNHINDERED SUPPLY OF GLASS BOTTLES FOLLOWING BAN ON PET BOTTLES

In the light of the proposed ban on use of PET (Polyethylene Terephthalate) for packaging medicines, the All India Glass Manufacturers' Federation (AIGMF) has approached the Union Health Ministry to reiterate glass industry's capabilities for unhindered supplies of glass bottles to pharmaceutical companies.

In a written submission, the AIGMF informed the Health Ministry that 'we would like to assure you that our members will ensure the availability of glass bottles to the liquid filling pharmaceutical units on priority basis throughout the year'.

The industry invested more than Rs. 5000 crore in the last 5 years to create capacities. This will enable the glass industry to cater to the additional demand from pharma industry.

According to AIGMF, in the light of the proposed ban on use of PET for packaging medicines, an ill-informed campaign was started on the characteristic of glass bottles and on its suitability for primary packaging of pharma products. This campaign started after the government issued a pre-notification on September 29, 2014 seeking suggestions for prohibition of usage of PET for pharmaceutical packaging.

AIGMF opines that the misconception created about price increase of drugs due to prohibition of PET packaging shows total disregard for human health especially of women and children.

Glass industry in India has a capacity of over 10,000 tons of glass per day which will convert to yearly capacity of almost 3.7 million tons. If it is required immediately industry has the capacity of over 1 million tons, which is more than sufficient to cater to the requirement. As a matter of fact, the pharmaceutical industry currently uses glass bottles to fill its 40-50 per cent requirement. The conversion from glass to PET/plastic packaging started only 8 to 10 years back for the sake of convenience, purely commercial benefits and due to lack of awareness.

AIGMF also opines that the impact of cost of packaging on the MRP is not so significant that the switchover from PET to glass should be of any issue to any manufacturer especially considering the huge health advantage women and children enjoy in the long run due to this switchover.

SAINT-GOBAIN EYES Rs. 10,000 CRORE REVENUE FROM INDIA

Riding high on the India growth story, building materials manufacturer Saint-Gobain targets over Rs 10,000 crore in revenues from the country by 2019.

"India has been an important market and investment destination for Saint-Gobain and, going forward, will be even more so. We see a strong and profitable growth of all our businesses here. We expect to more than double our business in India and to exceed sales of Rs 10,000 crore by 2019," Saint-Gobain General Delegate for India, Sri Lanka and Bangladesh, Anand Mahajan told reporters.

"We believe that we can play an important role in shaping the future by designing, manufacturing and distributing building and high-performance materials, which provide innovative solutions to meet the challenges of growth, energy efficiency and environmental protection," Mahajan said.

The company is celebrating its 350th anniversary this year and aims to strengthen its commitment by becoming the reference for sustainable habitat in India and doubling the business in the country in the next few years, he said.

Mahajan further said the company will focus on inventing products, solutions and systems for the buildings of the future.

"We will be reducing environmental impact of our industrial processes and supply chain and will contribute to the development of skills and techniques for modern, efficient construction, manufacturing and logistics," he said, adding the company has recently made investments in new facilities to serve global markets and this trend will continue.

GI CERTIFICATION FOR BANARAS GLASS BEADS CLEARED

Earrings, bracelets and neck-pieces made out of multi-coloured glass beads are a handicraft with roots in villages of Varanasi. The exclusivity

of these beads called 'kanch ke moti' would remain intact with Geographical Indication Registry of India agreeing to certify the handicraft.

An application to this effect was presented last year by export promotion commissioner, department of small scale industries and Banaras Glass Beads Association. "The application has been accepted and a gazette notification on it has been issued. The certificate would be awarded after March when the mandatory waiting period is over," said Chinnaraja G Naidu, Assistant Registrar of Trademarks and Geographical Registration India.

President of the Banaras Beads Association, Ashok Gupta informed that more than 5,000 artisan families in Varanasi, parts of Mirzapur and Sonbhadra manufacture 50,000 varieties of glass beads in different designs, shapes, sizes and colours. A worker may take 5-20 minutes to make a single bead.

Alok Kanungo—Assistant Professor, Archaeology Department, Indian Institute of Technology, Gandhinagar who has extensively studied the glass beads of India—finds Varanasi glass beads unique. He told there are three major glass bead industries in the country which not only produce the beads using traditional techniques but also export them; namely Papanaidupet (Chitoor, Andhra Pradesh), Puralpur (near Hathras) and Varanasi.

"The technique used in Varanasi, called lamp winding, makes it unique," he said. In this, glass is transformed into rods or sticks known as canes. Workers melt them at a small heat source, usually a lamp (hence the name). The glass is then wound around a wire. While the glass is still hot, the bead may be shaped or given decoration with other colours of the glass canes. Once cooled, beads are knocked down," explained Kanungu.

He added that ethnographically, beads are produced following this technique in Venice (Italy), Bihemia (Czech Republic), New Gablonz (Germany), Jombang (Indonesia) and in parts of China, France and USA.

Raahul Dutta, Counsel for the UP government who is pursuing the case, said that GI certificate would benefit craftsmen by safeguarding its uniqueness which has been challenged by men and machines in China. The state would also be able to generate revenue from the work ■

News Source: AIGMF Research Team/ World Wide Web

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GLASS News Worldwide

GLASSTEC AND GLASSPRINT RENEW COOPERATION - GLASSPRINT 2015 RETURNS TO DÜSSELDORF ON NOVEMBER 24-25

The world's most important glass trade fair, glasstec, and GlassPrint, Europe's only dedicated conference and exhibition for glass decoration have agreed to renew their successful cooperation. glasstec will 'power' GlassPrint 2015 and the two events will continue to mutually support each other.

Commenting on this, Birgit Horn, Director of glasstec, said: "We are pleased that GlassPrint will be hosted again by the glasstec city Düsseldorf. This contributes to Düsseldorf being not only the home of the global No. 1 trade fair for the entire glass sector every two years but also a centre of attraction for a major part of this industry in the years in-between glasstec. Decorative glass finishing is also a dynamic exhibition segment at glasstec, reflecting the great potential of this field."

Dave Fordham, Publishing & Events Director, Chameleon Business Media (Glass Worldwide) explains: "As co-organiser of GlassPrint with ESMA, we are very pleased that the 2015 event will be powered again by glasstec. In addition to our other sponsors, the support of a major organisation like Messe Düsseldorf has greatly enhanced GlassPrint and helped to provide even better value to the global glassmakers, decorators and suppliers in attendance."

On November 24-25, 2015, GlassPrint 2015 will be held at the Radisson Blu Scandinavia Hotel in Düsseldorf. Expert speakers will offer a series of technical conference presentations covering the latest advanced technologies for printing onto architectural, automotive and hollow glass with digital and screen applications.

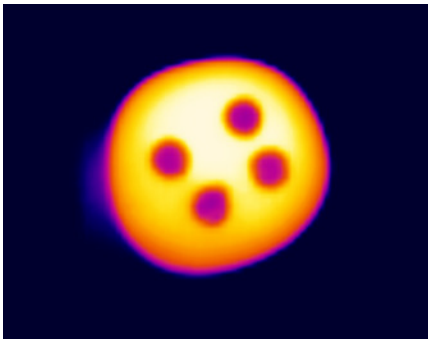
In addition, a series of keynote speeches covering flat and hollow glass will be presented by prominent industry figureheads representing glasstec (Messe Düsseldorf), BV-Glas, FEVE, Glass for Europe and the VDMA.

GlassPrint 2015 follows on from the 2013 event that was deemed an outstanding success by the record audience of approximately 200 attendees from 27 different countries.

GlassPrint is an event jointly organised by Chameleon Business Media, publisher of Glass Worldwide, and ESMA, a European association for specialist printing manufacturers. For further information and the conference agenda go to www.glassprint.org

GTS SET TO REVOLUTIONISE EYE-SAFE IMAGING MARKET

Independent research and development, consultancy and testing facility, Glass Technology Services Ltd (GTS), is set to revolutionise the eye-safe imaging market with its latest developments in glass-based laser rod design, following the award of grant funding by Innovate UK, the national innovation agency and the new name for the Technology Strategy Board.



The Advanced Composite Core-clad Eye-Safe Laser System (ACCES-LS) improves the thermal conductivity of laser rods, enhancing their performance while reducing costs to potentially half that of current processes.

"Conventional glass laser rods experience excessive heating during continuous use, leading to thermal lensing effects and damage to coatings," said Robert Ireson, Innovation Team Leader at GTS. "The eye-safe laser system offers significant reductions in size, weight and power requirements compared to current sensor technology and at potentially less than half the cost."

This project further builds on the established photonics and material science expertise at GTS and their scientists are already working with Thales UK's Optronics business in Glasgow on the Light-MiLES project, which was awarded an Innovate UK grant to forward advances in technology and innovation, developing eye-safe laser systems. Other partners in the specialist consortium include Gooch & Housego Ltd and the University of Leeds.

The GTS portfolio of current, non-confidential, projects is available online at www.glass-ts.com/projects

GLASS PACKAGING INDUSTRY MAKING THE EU CIRCULAR ECONOMY REAL

The Container Glass sector in Europe brings value to Europe's social, environmental and economic welfare according to findings from an Ernst & Young study commissioned by FEVE.

The capital intensive container glass sector is a fundamental part of Europe's packaging sector and has a longstanding contribution to Europe's heritage. Annually, it invests up to €610 million to innovate and maintain a network for 155 plants across the EU. This equals 10% of the industry's operational costs every year. The industry contributes €9.5 billion yearly to the EU GDP, and has a positive impact on Europe's trade balance of €21 billion for products primarily packed in glass.

Some 125,000 direct and indirect jobs are maintained by the sector supporting a wide range of other industries in local regions as glass plants deliver more than half of their products within 300km and more than 70% of raw materials travel less than 300km.

The container glass industry is the prime example of a well-functioning circular economy. We are reducing our environmental footprint thanks to the effective bottle-to-bottle closed loop recycling. This is what allows the sector to collect seven out of every 10 bottles for recycling - meaning one ton of recycled glass saves 1.2 tons of virgin raw materials and cuts CO_2 emissions by 60%. The E&Y study points out the environmental credentials of the industry due to the inherent properties of glass, but also underscores the fact that bottle-to-bottle recycling can deliver a true circular economy.

"Industries that help further a circular economy should be supported" commented Seb Dance, Member of the European Parliament with the Progressive Alliance of Socialists and Democrats, at the dinner debate "Essentials of a European Circular Economy" where the study was presented. "In times of sluggish economic growth, we need to encourage long-term and sustainable business models that are able to turn waste into reusable resources and by doing so support the creation of stable, local jobs in the EU."

"Closed loop bottle to bottle recycling is key to making the Circular Economy real," commented Adeline Farrelly, Secretary General of FEVE – "Closed loop recycling decouples the demand for resources against much needed growth in Europe. This is a major opportunity for the European economy to get out of deep water."

The container glass industry, NGOs and several groups in the European Parliament are calling on the European Commission to ensure that the Circular Economy Package remains on the EU agenda – as it is an important tool to reconcile Europe's environmental objectives with economic growth.

INNOVATIVE 3D LASER CUTTING OF GLASS

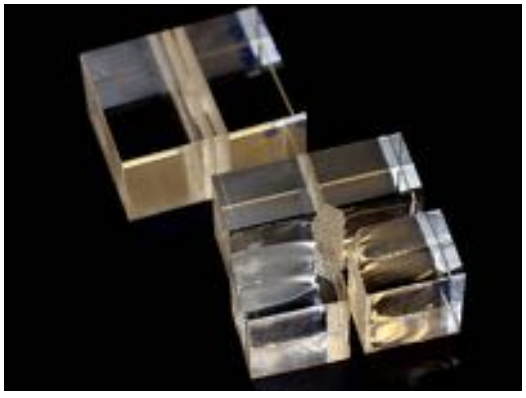
Glass Technology Services Ltd (GTS), is developing a novel laser process to optimise the production of customised three dimensional glass components.

Designed to meet increased industry demand for low-cost, flexible manufacturing of complex glass shapes, 3D Clear-Cut will enable several pieces to be laser-cut from a single block of glass.

"It is difficult to produce small, complex, 3D shapes to a high degree of precision using conventional glass processing technology," said Robert Ireson, Innovation Team Leader at GTS. "It is hoped that the novel laser process will have minimal energy input, with the option of controlling certain optical properties. Customised 3D shapes can be manufactured with this non-contact process in a short time frame, with high precision and minimum waste, meeting extensive demand across the industry for flexible, energy-efficient production of glass components, particularly for use in the photonics applications, including lasers and sensors."

The new process will complement a separate major development project under way at GTS to produce innovative, compact, low cost and eye-safe laser-illuminated imaging sensors, for use in optical communications, medical diagnostics, remote sensing, range finding and targeting.

Photonics and material science experts at GTS are working with project leaders, Thales UK's Optronics business in Glasgow, on the Light-MiLES project, which has been awarded a grant by Innovate UK, the national innovation agency and the new name for the Technology Strategy Board, to forward advances



in technology and innovation. Other partners in the specialist consortium include Gooch & Housego Ltd and the University of Leeds ■

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

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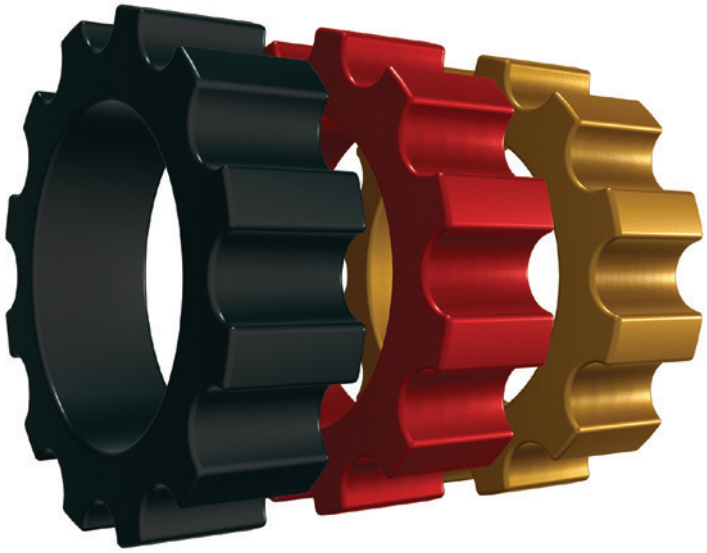
Prime movers for sustainable solutions

The German mechanical engineering industry is a highly innovative sector, as the following VDMA contribution explains.

With a total sales volume of more than €200 billion, the industry's total expenditure on research and development amounts to roughly €5.8 billion, a figure that represents a particularly high ratio. Otherwise, the industry would not be able to maintain its position as a technology leader in many fields. Of course, well-trained and highly educated personnel are also needed to be successful in the long run.



COMPETITIVE EDGE

In times of scarce resources and growing concerns for the environment, 'green' technology is an important trend in the area of glass machinery and plant production, all the more so because the industry belongs to one of the world's most energy-intensive sectors. From batch handling and mixing to glass melting and forming processes through to further processing and finishing, the glass industry has witnessed an upsurge and further development in sustainable technologies.

German engineering companies are prime movers for these sustainable solutions, with special focus on such subjects as energy and resource efficiency, life-cycle costs, improving yield and the quality of end products. This clearly gives them and their customers a competitive edge, a fact that is also reflected in the strong response to the Blue Competence campaign created by the German Engineering Federation, VDMA. Companies bearing this label are characterised by sustainability playing a major role throughout their business units and activities.

CUTTING PRODUCTION COSTS

In the area of product innovation, there is of course a trend towards lightweight glasses and multi-functional glass incorporating such features as heat, sun and noise protection, as well as safety and design. The production technologies needed to make this happen are offered.

Process optimisation is also one of the sector's main fields of business. Customers of German glass machinery can look forward to discovering innovative concepts, enabling them to use their existing capacities most effectively, to accelerate production and use less energy.

If the value chain in production is organised in such a way that all steps fit one another perfectly and are dovetailed, production costs can be cut significantly, regardless of whether hollow, flat, solar or other special glass is produced. Up to 80% of the energy needed to produce glass is used in the melting and refining processes. This is where German industry has put special focus. Energy savings can be achieved for example by advanced technologies such as glass batch preheating, advanced refining systems, the latest conditioning and cooling systems and the innovative process of continuous chemical tempering of glass.

FIERCE COMPETITION

The industry generates about two-thirds of its turnover from exports. European countries are still the leading sales market, with impetus coming especially from Eastern European nations. China, however, is becoming increasingly important and has almost reached the level of Europe as the most important export market. Demand from Latin America is increasing and companies see good possibilities arising in the mid-term from the Far and Middle East, as well as India, which will have a significant demand for glass over the next couple of decades.

Competitive constraints are on the increase worldwide. More and more customers are asking for turnkey projects, which can only be fulfilled when companies co-operate closely with their partners. Trying to meet this demand bears risks. The same is true when wanting to >

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cater for requests to have a financing plan in place when negotiating deals.

In addition, cheap offers, especially from Chinese companies, create difficulties for German suppliers. Most companies try to avoid competing on price but prefer to gain credit from the quality and service offered and/or by convincing customers of their high technology, as well as aspects regarding energy efficiency and the environmental friendliness provided by their machinery. And of course, there is the worldwide excess capacity of flat and solar glass with which to contend, due to the difficult situation in which the photovoltaics industry currently finds itself.

Competitors from around the world are catching up but with highly innovative machines and tailor-made solutions, strong customer support and real benefits offered in terms of life cycle costs, German suppliers remain confident they will continue playing a major role as a long-term partner to the glass industry. This is an innovative and competitive industry that is looking forward to meeting future challenges.

ABOUT VDMA

VDMA has more than 3100 member companies in the small and medium business-dominated engineering industry in Germany and is one of the most influential business associations in Europe. As such, the organisation is lobbying for its industry's interests, for example in the field of deregulation, education, tax or research policies, corporate financing or environmental and energy regulations. In addition, however, VDMA is are also a service provider, advisor and communicator for members when it comes to management or legal questions, standardisation, market figures or statistics, recruitment or research funds, export promotion etc.

Furthermore, opportunities and platforms are provided for manufacturers, partners, customers and suppliers to get to know each other, to share experiences and even to work together on various projects. And, of course, VDMA is also the point of information for people who want to know more about the industry or who seek business contacts. VDMA is a recognised and reliable partner for trade show organisers, the media and other industry-related partners.

Forum Glass Technology is an industry section of the VDMA and has more than 60 member companies. They come from all sector of glass engineering and supply technology for producing, processing and refining flat glass, hollow glass and special glass alike. In total, however, there are some 150 VDMA member companies working on glass-related topics, including laser technology, robotics and automation or PV. ■

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www.bluecompetence.net

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- Spares for above.

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Journey from Guidelines to Indian Standard 16231 (Part 4): 2014 – A CCPS Initiative

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ccps@ccpsindia.com

In the modern lifestyle, increased Glass use in buildings offers many advantages and during last few years, glass became a favored feature in buildings and is used extensively in both exterior and interior applications. As per an estimate domestic float glass sale of 886 MT/day in 2000-01 has been increased to 4006 MT/day in 2014-15 (April-June). Glass is popularly utilized in the construction of several elements which include facades, display windows, skylights, skywalks, entrances, revolving doors, canopies, winter gardens and conservatories. Glass being fragile in nature therefore 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., was very crucial. Wrong selection of glass type was widespread and resulted in increased heat gain/loss in buildings, the higher risk of human injuries to humans and problem faced by the Fire Brigade while carrying fire fighting and rescue operations.

Guidelines on Use of Glass in Buildings: Human Safety

Recognizing the gravity of the problem, necessity of Guidelines suggesting how to regulate glass in relation to human safety, was felt by the industry and IGMA (now part of AIGMF) came forward to assign the project to Confederation of Construction Products and Services (CCPS) - a not for profit organization. CCPS prepared the "Guidelines on use of Glass in Buildings – Human Safety" for the Indian Construction Industry in a record time of eleven months adopting consensus method entirely lead by the private sector and supported by industry and involving stakeholders and government like CPWD, M/o UD, various PWDs, major municipalities, IBC, CEAI etc. Steering Committee was constituted to decide the scope, methodology and guide the proceedings. In order to ensure the integrity of the process, the changes at each stage were discussed and documented. Meetings were organized at Delhi, Mumbai, Bangalore and finally at Delhi, so as to ensure wider involvement and participation of various organizations and professionals throughout the country. The final draft was approved in the Steering Committee meeting held on November 2, 2007 and Guidelines were printed and widely circulated for propagation and adoption.

Planning Commission has also taken note of increased glass use in buildings that too without following any safety norms or guidelines and a meeting was called by Mr. Anwarul Hoda, the then Hon'ble Member (HUD), Planning Commission on 12.12.2008 in Yojana Bhawan, where CCPS gave a presentation on the Guidelines. Hon'ble Member expressed his concern at the absence of standards and guidelines on safety while using glass in buildings in the country. Hon'ble Member stressed the need for inclusion of conditionality in Building Byelaws and issued letters dated 04.02.2009 and 26.11.2009 to Principal Secretaries of HUD Deptts of all States and UTs to ensure human safety while using glass in buildings.

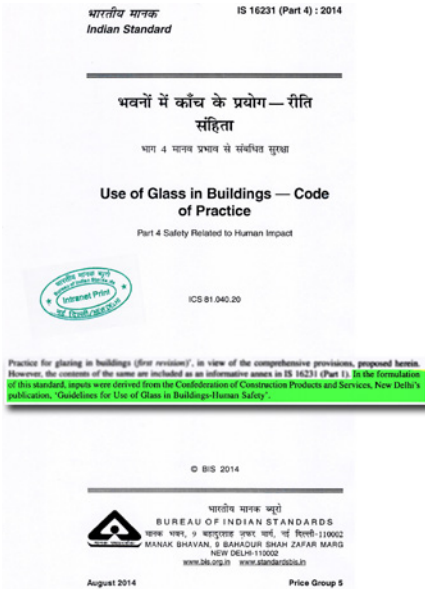
Since the main concern was of human safety, an Expert Committee was constituted in May 2008 under the

Mr Deepak Gahlowt, Convener CCPS delivering lecture on "Selection of glass and safe use of glass in buildings" to Civil Engineering students of Amity University on Oct 10, 2013

Chairmanship of Mr. P. B. Vijay, former DG, CPWD having representation from Indian Buildings Congress (IBC), Consulting Engineers Association of India (CEAI), CPWD, CCPS and stakeholders to review and analyse the CCPS Guidelines. Expert Committee met over five meetings and suggested amendments which were included in the modified edition. Guidelines were reviewed from time to time and a chapter on 'Suggestions for Fire Safety' was added in the third addition. While writing Preface to this edition, Mr. T. Nandakumar, Member, National Disaster Management Authority, New Delhi appreciated the efforts of CCPS and AGP-AIGMF for shouldering the responsibility and working for the cause of human safety.

CCPS made all efforts to propagate the Guidelines for getting the Guidelines implemented in the country which include organizing Workshops, Training programs, Seminars, presenting papers and giving presentations, attending meetings, writing to all concerned which resulted in implementation of Guidelines by 19 States and Central & State Govt. Depts., PSUs and eminent construction agencies, which include Central PWD, Govt. of Andhra Pradesh, Govt. of Rajasthan, NBCC, Airport Authority of India, Haryana PWD, Delhi PWD, DDA, JDA, ITPO, Amity School of Engineering and Technology, Ahluwalia Contracts (I) Ltd., Mumbai Fire Brigade, BMC etc.

With the continuous persuasions of CCPS, Bureau of Indian Standards (BIS) also agreed to formulate standard on "Safe use of glass in buildings" covering comprehensive components in the Sectional Committee CED 13 meeting held under the Chairmanship of Mr. D. S. Sachdev, on 05.11.2008. A specialized Working Group on Safe use of glass under the Chairmanship of Mr. R. N. Dandekar, Chief Engineer (CDO), CPWD comprising of 8 members including CCPS was also constituted by BIS for preparing drafts on various parts/sections of the proposed glass standard. Finally, IS: 16231 (Part 4): 2014 on "Code of Practice on use of Glass in Buildings - Safety Related to Human Impact" has been uploaded by Bureau of Indian Standards on November 17, 2014 and is now available for Sale. BIS has



भारतीय मानक
Indian Standard

IS 16231 (Part 4) : 2014

भवनों में काँच के प्रयोग — रीति संहिता

भाग 4 मानव प्रभाव से संबंधित सुरक्षा

Use of Glass in Buildings — Code of Practice

Part 4 Safety Related to Human Impact

ICS 81.040.20

Practice for glazing in buildings (*first revision*)', in view of the comprehensive provisions, proposed herein. However, the contents of the same are included as an informative annex in IS 16231 (Part 1). In the formulation of this standard, inputs were derived from the Confederation of Construction Products and Services, New Delhi's publication, 'Guidelines for Use of Glass in Buildings-Human Safety'.

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August 2014

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duly endorsed in the 'Foreword' that this Standard has been derived from CCPS 'Guidelines on use of Glass in Buildings-Human Safety'. Our efforts have been proved successful and one of the important and desired targets has been achieved. CCPS is committed to continue to strive and work for getting the recommendations of CCPS Guidelines and IS: 16231 (Part 4): 2014 included in the revised National Building Code 2015, Byelaws of Local Bodies and Development Authorities and wide propagation to ensure human and fire safety while using glass in buildings ■

Mr. Shashi Kant Adviser, CCPS & Mr. D. S. Sachdev in meeting with Mr. T. K. Anil Kumar, IAS, Secretary , U D Dept., Govt. of Karnataka & Mr. S. B. Hunnur, Director, TCPO on Jan 25, 2014

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A Perspective on Renewable Energy and Solar Photovoltaic Power Plants

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Abstract:

Among all the plate or sheet glasses, the "float glass" made by floating a sheet of glass over molten tin bath is the most popular and also technologically involved subject of concern to the building construction industry in general, and glass industry in particular. These sheet glasses are very useful in making solar panels for generating sizeable proportion of electrical energy from the sun light via photovoltaic (PV) cells that are adequate for lighting and other purposes for both residential and commercial buildings. A perspective of solar energy is discussed in this article to highlight the importance of this form of renewable energy that is highly congenial for the protection of our environment.

INTRODUCTION:

In the totality of the industrial activity, the building construction plays a very important role in any national economy, sometimes comprising of about 25% of GDP, e.g. in Singapore, where this industry is quite pervasive and visible almost everywhere in this city-nation. In a 10 ft by 10 ft room (i.e. 100 square ft area) with a height of about 10 ft, if one facade of this room is fully made by "glass" sheet, then the requirement of glass is 100 square ft (7-8 mm thick) for a 100 square ft room, i.e. the ratio is just 1. This ratio varies with the design of the building and our desire to see light. However, depending on such design, as the building construction activity increases in the evolving economy, the requirement of the glass also increases. This is good news for the glass industry, if they could convince the user industry to consume more and more of glass facade in the design of their buildings. This is also guided by the 'transparency' of glasses, as described for float glasses in various issues of Kanch, particularly in Ref. **[1]** and **[2]**.

In this context, we cannot forget about Charles-Edouard Jeanneret-Gris (born in 1887), popularly known as Le Corbusier, who was a Swiss-French architect, designer, painter, urban planner, writer, and one of the pioneers of what is now called "modern architecture". Le Corbusier once said that "Light is Necessary so that the 'Matter' can Manifest itself and be Visible". This concept has been extensively used in the design of the buildings in the modern era. Another important industry is "electrical energy" that is used by the consumers who inhabit such buildings. This electrical energy is mainly produced via thermal route by burning coal, although there are other important sources for electric power generation, such as nuclear, hydro, wind, solar, etc.

However, due to burning of coal, there is an emission of carbon dioxide which creates an environmental problem for all of us. In all the "multi-lateral environment" conferences, there is a tremendous effort for each country to reduce the level of emission of such toxic gases, and they even go to the extent of giving "carbon credit" to those countries who comply with the acceptable norms. This takes us to non-conventional but renewable energy like solar, wind, etc. For example, Germany produces 6% of its total power generation via solar energy route thereby making it the most laudable contender for carbon credit. Here, before talking about

solar energy, let us talk briefly about some data on power.

It is important to understand the gigantic nature of the top ten major power plants in the world, although none of them are 'thermal power' plants. Seven out of the top ten are actually renewable, i.e. hydro-electric and three are nuclear.

Even among the top 20 major power plants, 11 are hydro-based and 6 are nuclear plants. Only 1 each is based on coal, natural gas and fuel oil respectively, but none of these plants is in India indicating that we are still far apart from polluting the earth's atmosphere, although this complacency is not desirable under any circumstances. The above is a list of the top ten power plants in the world. While there are 3 such large plants in China and 2 in Brazil, there is 1 plant each in USA, Canada, South Korea, Japan and Venezuela respectively. The total installed capacity for ten plants alone is more than 100,000 MW, and the combined power generation is over 500,000 billion units serving well the need of these countries. India's position in this respect is quite dismal, although there is too much talk about power generation.

The debate on different modes of power generation will continue in the world, but there is no denying the fact that despite having more than a billion tons of reserves of 'good coal' in India, we should desist from exploring the prospect of "solar energy". We as glass technologist have a strong interest in developing a solar energy market so that the demand for sheet glass will go up by the day with the increase in the value-added building construction segment. Although there is a temporary set-back in terms of financing large building projects, this industry will prosper with 100% FDI in the sector, and eventually through the infusion of 'private equity' capital from USA and other countries, who are flush with funds.

Hence, the glass industry in India could try to develop a strategy of attracting the prominent private equity investors, as many of them have already invested heavily in the real estate market of USA as well as in the Euro zone, particularly in Spain. Moreover, it is a very plausible strategy for our future that is also viable, as the sunlight is free as a raw-material for power generation compared to that of coal or fuel oil, which is becoming costly day by day, thereby increasing the power bill of general consumers as well as having higher expenditure on the glass production cost. Next, to understand the impact of solar energy generation, let us have a comparison with another renewable source of energy, i.e. wind energy.

Name of the Plant	Country	Type	Capacity (MW)	Annual Power Generation (Billion Units)
1. Three Gorges	China	Hydro	22,500	92,200
2. Itaipu	Brazil	Hydro	14,000	98,630
3. Xiluodu	China	Hydro	13,860	57,100
4. Guri	Venezuela	Hydro	10,235	47,000
5. Tucurui	Brazil	Hydro	8,370	21,400
6. Kashiwazi	Japan	Nuclear	8,200	60,300
7. Bruce NGS	Canada	Nuclear	6,810	45,000
8. Grand C. Dam	USA	Hydro	6,800	21,000
9. Longtan Dam	China	Hydro	6,400	18,700
10. Hanul	S. Korea	Nuclear	6,175	48,160
		TOTAL =	103,340	509,490

WIND VS. SOLAR ENERGY:

First of all, a distinction has to be made between these two forms of energy. Both are renewable and both are naturally available without paying any cost on raw materials, like coal or fuel oil. However, the weather department goes through a very complicated process of computer modelling and calculations to predict the wind directions and speed that determine the efficiency of wind power system. In order to sustain the required power generation level, i.e. efficiency, the weather prediction has to be correct. The weather report for the availability of 'sun shine' is more or less predictable. In other words, except in some specific locations, solar power can be generated almost everywhere and with the advent of technology of "tracking system", the orientation of solar panels could be changed to get the optimum output. In case of wind power, this cannot be said and certain specific locations are intentionally chosen, where the wind speed is certain to be quite adequate for the purpose of making the wind turbine work effectively. This excludes the other merits and demerits of these systems of generation of electrical energy with the relevant details on the cost of investment.

Here, of course, no comparison is made between the respective technology, as both are quite extensive and driven by strong R & D work. So, there is always an angle of "investment" for the future. From the general statistics, it is known that "wind power" expanded by almost 20% in 2012 around the world to reach a new peak of 282 gigawatts (GW) of total installed capacity, while solar power reached more than 100GW, having more than doubled in two years, up from 71GW in 2011 and just 40GW in 2010. More than 45GW of new wind turbines arrived

in 2012, with China and the USA leading the way with 13GW each, while Germany, India and the UK were next with a capacity in each of about 2GW.

Due to some financial problems, China paused for some time, while both the US and European markets had exceptionally strong years, as per the report of Global Wind Energy Council (GWEC). Moreover, the report added that Asia still led the global markets, but with North America a close second, and Europe not far behind. In the world for installed wind power, the UK now ranks sixth with 8.5GW, while in Europe, only Germany (31GW) and Spain (23GW) rank higher. However, undisputedly, China leads the world with 77GW of installed capacity and the US is second with 60GW.

Due to technological development, the UK is by far the world leader in "offshore" wind deployment, installing 0.85MW in 2012 to bring the total so far to 3,000MW. Denmark in this respect ranks second with a total of 900MW installed, and Belgium is ranked third with 400MW. This part of the success story in these countries speaks of the sustained efforts by their department of energy as well as by the climate change advocacy. For the future low energy carbon, the technology is driven forward with 6MW "offshore turbine" currently under installation in the North Sea.

As per the report of GWEC on the market consolidation that is pinpointed as the reason of a relative slowdown in China, while "a lapse in policy" caused a similar slowdown in India, but it is expected that the Asian dominance of 'global wind markets' will continue. The record year for installation in the USA was driven by a rush to beat an anticipated end to tax credits: 8GW of the total 13GW were installed in the last quarter of 2012. However, the tax credit has since been extended by the Federal Govt., which means that a dramatic slowdown in the USA is less likely in the future. The report further added that the outlook for 2013 in Europe was uncertain due to the Euro-zone debt crisis, but that the EU's legal commitments and 2020 targets for renewable energy ensured "a degree of stability".

There is very little wind power installed in Africa, but sub-Saharan Africa's first large commercial wind farm came on line in 2012, i.e. a 52MW project in Ethiopia. This seems to be just the beginning of the African market. With construction started on over 500MW in South Africa, it is expected that Africa will be a substantial new market, where clean, competitive, energy generated with the indigenous sources is a priority for economic development.

As said earlier, solar power reached 100GW installed capacity in 2012 for the first time, according to data from the European Photovoltaic Industry Association (EPIA), up from 71GW in 2011 and just 40GW in 2010. The largest market by far is Europe, with Germany (32GW total) and Italy (16GW) being the leaders. However, while solar panel connections in Europe fell by 5GW in 2012 compared to that in the previous year, the installations rose by 5GW in the rest of the world, notable China, the USA, Japan and India. This actually made up the shortcoming and kept the pace ahead. As per the report of EPIA, even in tough economic times and despite growing regulatory uncertainty, the performance of the year 2011 has been maintained in 2012. However, a continued oversupply of solar panels would most likely make 2013 a "difficult year" for photovoltaic companies. Accordingly, there is a fall of investment in all renewable energy of over 10%, which has been due to large Govt. support in the USA, Spain, and Italy. However, it continues to rise in Asia that auger well for India.

Recently, the International Energy Agency (IEA) noted that low-carbon energy was growing quickly, driven largely by state subsidies. However, the IEA highlighted that fossil fuels received six times more subsidy, i.e. 523 billion US dollars in 2011 that is up 30% from 2010 level than low-carbon energy. There is still some scope of development of renewable energy in general and solar energy in particular in India as long as the subsidies are focussed with a correct strategy. Without going into the details of technology that will be dealt with in another issue of Kanch, next let us talk about the photovoltaics (PV).

PHOTOVOLTAICS:

Photovoltaics (PV) is a method of converting solar energy into direct current electricity using semiconducting materials that exhibit the photovoltaic effect. Semiconductors are intermediate between the (a) metals, where electrons flow freely without any bandgap, and (b) dielectrics or insulators, where there is a larger bandgap so that electrons cannot flow showing very little or no conduction of electricity. With the improvement of semiconductor technology, a lot of solar energy is being produced by harnessing their potential. It has to be also added that the light (i.e. solar light) is like waves. In the context of duality, these waves when quantized gives rise to the concept of quantized particles like 'photons'. So, the photons of Sun light have a great role in converting solar energy or radiation into electrical energy via the electrons in the semiconductor with

a reasonable band gap. The photons from the solar light excite the electrons from the lower valence band to higher conduction band within different type of "solar cells", i.e. semiconducting materials (like silicon), imprinted on the sheet of glass that generates the electric current.

A photovoltaic system employs "solar panels" (made of sheet glass) that is composed of a number of "solar cells" imprinted on them to produce usable solar power. Power generation from solar PV has long been seen as a clean and sustainable energy technology **[3]**, which draw upon the planets' most plentiful and widely distributed renewable energy source, i.e. the Sun. The direct conversion of sunlight to electricity occurs without any moving parts or environmental emissions during the operation. It is well proven, as photovoltaic systems have now been used for fifty years in specialized applications, and grid-connected PV systems have been in use for over twenty years **[4]**.

Driven by the advances in technology and increases in manufacturing scale and sophistication, the cost of photovoltaics has declined steadily since the first solar cells were manufactured **[4,5]**, and the levelised cost of electricity (LCOE) from PV is competitive with the conventional electricity sources in an expanding list of geographic regions **[6]**. Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity, have supported solar PV installations in many countries **[7]**. With current technology, photovoltaics recoup the energy needed to manufacture them in 1.5 (in Southern Europe) to 2.5 years (in Northern Europe), as per the data compiled by various sources **[8].**

Solar PV is now, after hydro and wind power, the third most important renewable energy source in terms of globally installed capacity. More than 100 countries use solar PV. Installations may be ground-mounted or, built into the roof or walls of a building; this could be building-integrated photovoltaics to reduce overall cost or simply on the rooftop. The ground-mounted installations, mostly done in the country-side where the land space is available, could also be integrated with "farming and grazing" that should definitely be very popular in the Northern Hilly areas in India to harness the real potential of PV technology. It also opens up the possibility of making the electricity reach to the distant locations in the Himalayan or similar regions, where there is a plenty of sunlight almost everywhere.

In 2013, the fast-growing capacity of worldwide installed solar PV increased by 39% to 139GW. This is sufficient to generate at least 160,000 billion Kwh or units, i.e. about 0.85% of the electricity demand on the planet. China, followed by Japan and the USA, is now the fastest growing market, while Germany remains the world's largest producer, contributing almost 6% to its national electricity demands, as said earlier. Looking at the immense possibility of using solar panels and consequent increase of demand of float glass in India, it is quite tempting to record some of the great producers in the world in order to attract the attention of all concerned in the energy sector in India. Next, let us give some details on the largest solar energy plants in terms of top twelve producers in 2014.

Name of the Plant	Country	Capacity (MW)	Annual Power Generation (Million Units)	Remarks
1. Topaz Solar Farm	USA	550	1096	550 MW reached in November, 2013
2. Desert Sunlight Solar Farm	USA	550	1050	Final stage reached in January, 2015
3. Longyangxia Dam Solar Plant	China	320	640	Full load reached in December, 2013
4. California Valley Solar Ranch	USA	292	399	First 130MW reached in February, 2013
5. Agua Caliente Solar Project	USA	290	626	Thin-film Cell with no Tracking System
6. Antelope Valley Solar Ranch	USA	266	525	With Govt Loan Guarantee
7. Mount Signal Solar	USA	266	520	Full load reached in May, 2014
8. Charanka Solar Park	India	224	408	Collection of 17 co-located plants
9. Mesquite	USA	207	413	8 lacs Panels (Sempra Energy)
10. Huanghe Hydro. Goldmud	China	200	317	Pure PV Plant (Yingli Solar)
11. Gonghe Industrial Park (Phase-1)	China	200	300	Full load reached in December, 2013
12. Imperial Valley Solar Project	USA	200	300	Full load reached in August, 2013
	TOTAL =	3,015	5,498	

Apart from the above dozen of the largest plants, there are some other solar PV power plants, notably the "Catalina Solar" with an 'annual power generation' capacity of 204 million Kwh or units (MU) in a 143MW plant in California (USA), which offsets 74,000 tons of gas emission (i.e. tough standard), "Silver State" in Nevada (USA) with 122 MU (98MW plant), which involves thin-film solar farm, one in Ontario (Canada) named "Sarnia PV" with a capacity of 120 MU (97MW plant) that involves 13 lacs panels with cadmium-telluride thin-film technology. There are also three more plants in China: namely "Xitieshan PV" in Qinghai with a capacity of 164 MU (100MW plant) that was No. 1 in 2011 developed by CGN and "Ningxia Qingyang" in Ningxia with a capacity of 150 MU (100MW plant) that was developed by GCL Poly (Hong Kong), and "Gansu Jiayuguan Solar Park" also with a capacity of 150 MU (100MW plant). This is not an exhaustive list, but it is given here to show the order of magnitude of the solar PV power generation plants ultimately to have an idea on the size of the projects. This should encourage the local investors to tie up their capital that is usually required for such projects **[7-9]**.

Several solar photovoltaic power plants around 150MW capacity or below have been built, mainly in Europe. As of July 2012, some other large photovoltaic (PV) power plants in the world are the Solarpark Meuro (Germany, 166MW), Neuhardenberg Solar Power (Germany, 145MW), Templin Solar Park (Germany, 128.5 MW), Toul-Rosieres Solar Park (France, 115MW), Perovo Solar Park (Ukraine, 106MW) developed by Active Solar (Austria), Brandenburg-Briest Solarpark (Germany, 91MW), Solarpark Finow Tower (Germany, 84.7MW), Montalto di Castro PV Power Station (Italy, 84.2 MW), Eggebek Solar Park (Germany, 83.6 MW), Senftenberg Solarpark (Germany, 82 MW), Finsterwalde Solar Park (Germany, 80.7MW), Okhotnykovo Solar Park (Ukraine, 80MW), Lopburi Solar Farm (Thailand, 73.16MW), Rovigo PV Power Plant (Italy, 72MW), and the Lieberose PV Park (Germany, 71.8MW) **[9]**.

There are also many larger plants under construction, notably the Blythe Solar Power Project, which is a 500 MW photovoltaic station under construction in Riverside County, California (USA), and McCoy Solar Energy Project with a capacity of 750MW. There are so many others in the USA and Europe. Many of these plants are integrated with agriculture and some use innovative tracking systems that follow the Sun's daily path across the sky that is fitted with high quality sensors to generate more electricity than conventional fixed-mounted systems. There are no fuel costs or emissions during operation of the power stations, i.e, environment-friendly.

Therefore, Indian Glass Manufacturers under the aegis of AIGMF could start negotiations with the present "Central Govt" as well as "Private Equity" investors from Europe and USA to have an "integrated strategy" to finance such larger solar PV power plants. This power is not only meant for commercial and residential purposes in large metro cities, but also to produce a "very high-value vegetable items" in large "covered area" to be grown in colder climate in the Himalayan mountains or similar locations, which is of great interest to the concerned Govt. organizations. So, it is a viable strategy to ponder over and make implementation.

CONCLUSIONS:

A very general perspective on the application of 'float glass' is given in terms of solar photovoltaics power plants. First, a short view has been given with data on installed capacity in MW and annual power generation in million units in a dozen of top plants; then for some other larger plants in the USA and Europe as well as in China where a majority of activities are taking place. It is found that the application of solar PV plants for growing certain high-value items in the field of 'agriculture' in Himalayan and other similar locations could be considered important. A viable strategy for AIGMF members has been devised for a proper implementation ■

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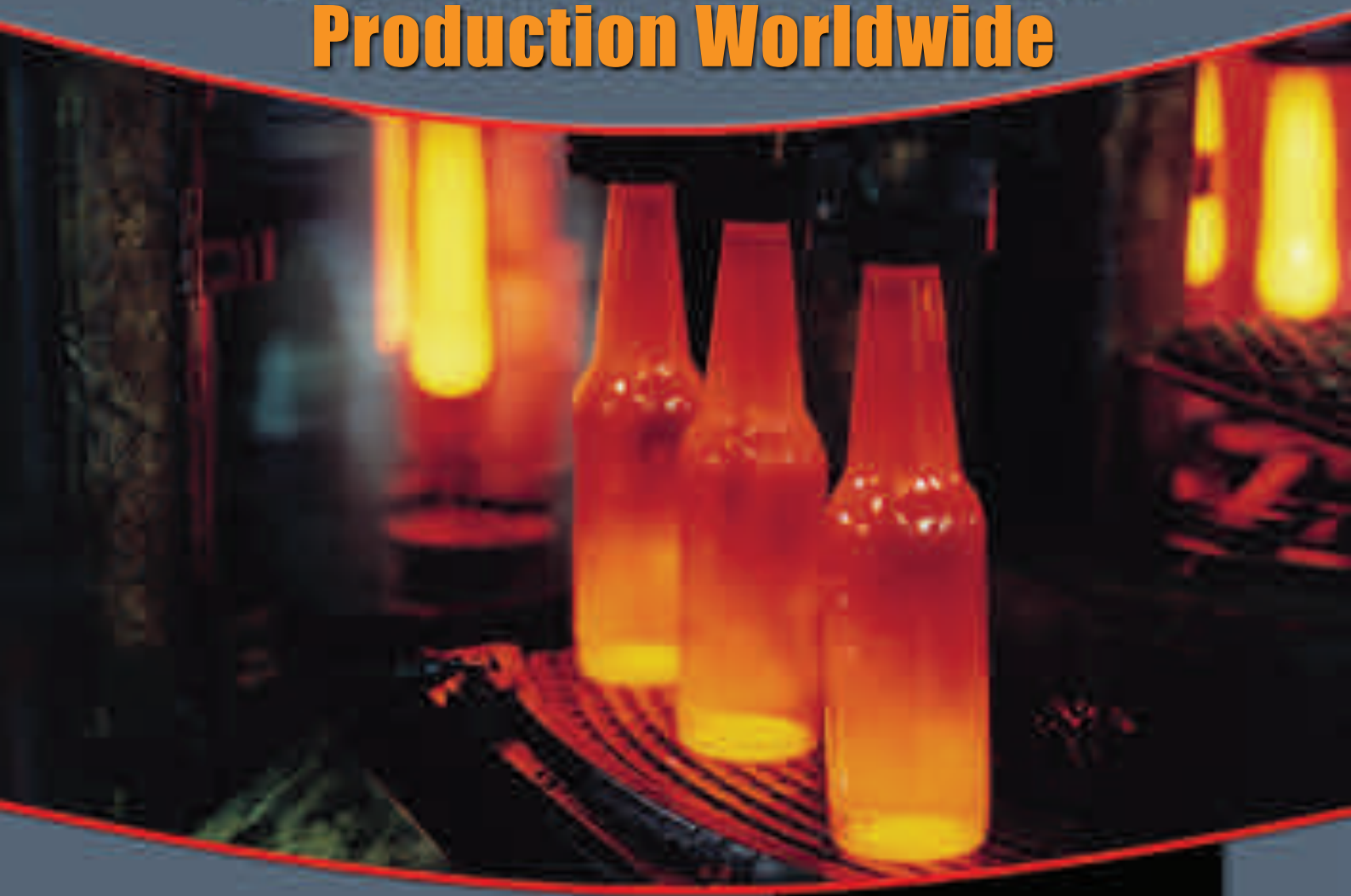

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- Target of renewable energy capacity revised to 175000 MW till 2022, comprising 100000 MW Solar, 60000 MW Wind, 10000 MW Biomass and 5000 MW Small Hydro
- National skill mission to consolidate skill initiatives spread across several Ministries to be launched
- 3 new National Institute of Pharmaceuticals Education and Research in Maharashtra, Rajasthan & Chattisgarh and one institute of Science and Education Research is to be set up in Nagaland & Orissa each
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- Central excise/Service tax assesses to be allowed to use digitally signed invoices and maintain record electronically
- Online central excise and service tax registration to be done in two working days
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- Service-tax plus education cesses increased from 12.36% to 14% to facilitate transition to GST
- Balance 50% of the additional depreciation on new plant or machinery acquired and used for less than 180 days which has not been allowed in the year of acquisition and installation of such plant and machinery, shall be allowed in the immediately succeeding year
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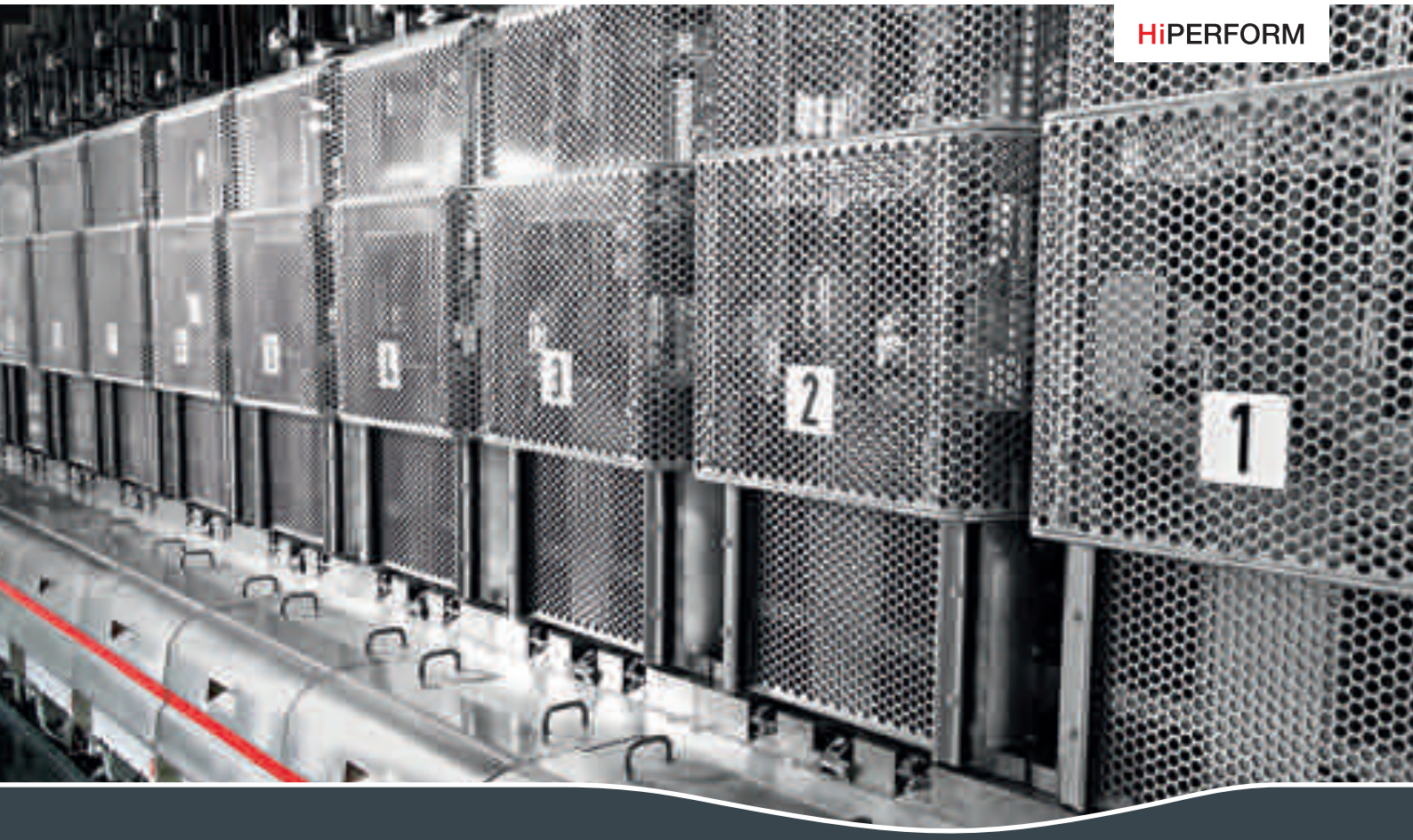

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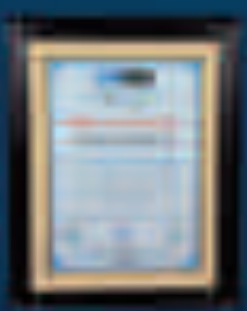


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E-Glass as an Important Component of Building Construction

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Abstract:

The "float" or sheet glasses with no surface aberrations give rise to a good transparency, but they have a very high emissivity or low reflectance so that undesirable light rays with wavelength in the infrared region of the solar spectrum are not filtered through the windows. A lower emissivity can be imparted in double or triple layers of window glasses with special coatings that considerably reduce the heat losses keeping the buildings cooler in the summer months, but warmer in the winter months. While this has a strong implication in the saving of energy, it also indicates much lower carbon dioxide emission, as desired by the environmental authorities. A description of the Low-E glass is given here that is under constant research and development in this field.

INTRODUCTION

It can be easily said that our "home", like a Bird's Nest, is a fundamental necessity of human beings, and everyone wants a 'sweet home' according to his capability for his dwelling in all hues and colours. Hence, the construction of buildings and houses will continue with the progress of time, as we shall always need them. It is also known that the float or sheet glass with no surface aberrations gives rise to a good transparency, and it is one of the most important components of construction for both interior and exterior of a given residential or commercial building, particularly during the last 15-20 years **[1,2]**. Here, we are mainly concerned with the windows or facades that make us see the light of the day, i.e. the visibility. However, recently, there has been a surge of activity for energy saving thereby enhancing the need to keep our houses and buildings cooler in the hot summer months and warmer in the winter months. This brings us to the subject of E-glass or rather Low-E glass, i.e. the float or sheet glass coated with special materials that have specific thermal property. Glass is one of the most popular and versatile building materials used today due to the reason of its constantly improving solar and thermal performance. This is achieved through the use of passive and solar control "Low-E" coatings. Here, "E" stands for emissivity.

In order to have a good grasp on coatings, it's important to understand the solar energy spectrum or energy from the Sun, which are divided into three parts: (a) Ultraviolet (UV) light, (b) Visible light and (c) Infrared (IR) light. They all occupy different parts of the solar spectrum – the differences between the three are determined by their wavelengths **[2]**. The UV wavelength of interest is from 300 to about 400 nanometers (nm), the visible segment of the spectrum spreads between 400 to about 700 nm, and the IR wavelength starts from about 700 nm going upto about 800 nm and beyond. Solar infrared is commonly referred to as short-wave infrared energy, while heat radiating off of warm objects has higher wavelengths than the Sun, and it is referred to as long-wave infrared.

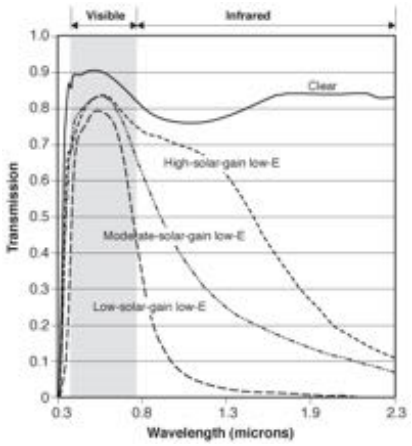
The components of solar radiation are: (a) 53% of IR component (i.e. thermal), (b) 44% of visible light (i.e. optical -- for our visibility), and (c) 3% of the UV light (energetic waves, but not visible). The latter is quite undesirable, as this has a bad effect on our skin and it also fades the colour of our dresses as well as other fabrics inside the building, such as

curtains, table tops, etc.. Any material (e.g. coated glass) can absorb, reflect or emit low levels of radiant (thermal) energy.

If any material absorbs the solar radiant energy in totality, then we call it a black-body. Emissivity is the value given to materials based on the ratio of heat emitted compared to a blackbody, on a scale from zero to one. A blackbody would have an emissivity of 1 and a perfect reflector would have a value of 0. Before we talk about "Low-E" glass, let us look at the transmission curve below at different wavelengths for a standard "clear" glass and those with different low-emissivity coatings are also shown to understand the spectral behaviour of Low-E glass (Courtesy: Lawrence Berkeley National Lab, California, USA).

WHAT IS LOW-E GLASS?

Low-E coatings have been developed to minimize the amount of ultraviolet (UV) and infrared (IR) light that can pass through glass without compromising the amount of visible light that is



transmitted. It is clearly seen from the above figure that the transmission curve of a high solar-gain E-glass has some similarity with that of a standard clear glass. Beyond visible band, the transmission starts falling quite sharply.

When heat or light energy is absorbed by glass, it is either made to get away via convection by moving air or re-radiated by the glass surface. The ability of a material to radiate energy is called its emissivity. All materials, including windows, emit (or radiate) heat in the form of long-wave (far-IR) energy depending on their temperature. This emission of radiant heat is one of the important components of heat transfer for a window. Hence, if we reduce the window's emittance or emissivity, it could greatly improve the insulating properties that drive the new surge in the manufacture and usage of E-glass in the booming building construction industry. This not only enhances our visibility but also consumes lesser energy thereby ensuring lesser carbon dioxide emission. This is good for our environment.

This is where low emissivity or Low-E coatings come into play. Low-E glass has a microscopically thin, transparent, coating that reflects long-wave infrared energy (or heat). Some Low-E's also reflect significant amounts of short-wave solar infrared energy. When the interior heat energy tries to escape to the colder outside during the winter, the low-E coating reflects the heat back to the inside thereby reducing the radiant heat loss through the glass. The reverse happens during the summer time. One simple analogy can be drawn in that low-E glass works the same way a 'thermal flask' does. A thermal flask has a silver lining, which reflects the temperature of the drink (hot tea or cold drink) back in. Thus, the temperature is maintained because of the constant reflection that occurs as well as the 'insulating benefits' that the air space provides between the inner and outer shells of the thermal flask, i.e. similar to an insulating glass unit or E-glass. Here, the same theory could be applied, since Low-E glass consists of extremely thin layers of silver or similar materials, i.e. the Low-E coating reflects the interior temperatures back inside, keeping the room warm or cold.

Low emissivity (Low-E or Low-(thermal) Emissivity) refers to a surface condition that emits low levels of radiant thermal (heat) energy. Reflectivity is inversely related to emissivity and when added together, their total should be equal to 1. Therefore, for a very well-known "reflector" material like aluminium, if it has a thermal emissivity value of 0.03, its thermal reflectance value would be 0.97. This means that it absorbs and emits only 3% of radiant thermal energy and reflects 97%. Conversely, a High-E material reflects lesser amount of solar radiation and emits relatively more of the radiation energy, i.e. a standard "float" glass.

Standard clear glass has an emittance of 0.84 over the long-wave portion of the 'solar energy' spectrum, meaning that it emits 84% of the energy possible for an object at its temperature. It also means that 84% of the long-wave radiation striking the surface of the glass is absorbed and only 16% is reflected. By comparison, Low-E glass coatings can have an emittance as low as 0.04. Such glazing would emit only 4% of the energy possible at its temperature, and thus reflects 96% of the incident long-wave (IR) radiation. The manufacturers of low E-glass windows give product information that does not list "emittance ratings". The effect of the Low-E coating is rather incorporated into the U-factor for the unit or glazing assembly.

The 'solar reflectance' of Low-E coatings can be manipulated to include specific parts of the visible and infrared spectrum. If the visible part is permitted, we get good (or enough) visibility, and if certain portion of IR band is also allowed, then such a combination becomes the genesis of the term 'spectrally selective coatings'. This ensures the desirable wavelengths of energy that has to be transmitted and others specifically reflected. A glazing material can then be

designed to optimize 'energy flows' for solar heating, day-lighting and cooling **[3]**. This could be also considered as an 'energy issue' combining the power of solar energy as well as the novelty of "float" glass to drive the technology of E-glass.

So, an uncoated smooth glass, e.g. window glass, has a very high emissivity value of 0.84 meaning thereby only 16% is reflected; incidentally, silver that is a good coating material has an emissivity value of 0.02. This brings us to the subject of coating 'glass surface' that has substantially lower emissivity so that we could achieve a proper thermal property, which is very much a necessity for a proper building design. Apart from window glass manufactured with metal-oxide coatings, the components of 'low-emissivity building' include other materials as well, such as house-wrap materials, reflective thermal insulations and other forms of radiant thermal barriers. All materials absorb, reflect and emit radiant energy, but here, the primary concern is a special wavelength interval of radiant energy, namely thermal radiation of materials with temperature in the range of 40 to 60^{0}C. Next, let us briefly look at different methods of coating, before we embark on the performance of E-glass.

DIFFERENT METHODS FOR E-GLASS

As said above, 'window glass' is by nature highly thermally emissive. So, to reduce its emissivity eventually to improve the thermal efficiency (i.e. insulation properties), thin film coatings are applied to the raw soda-lime-silica glass or "float" glass. There are two primary methods in use **[4, 5]**:

1) Pyrolytic Chemical Vapour Deposition (CVD), and
2) Magnetic Sputtering.

Specially designed coatings are applied to one or more surfaces of insulated glass. These coatings reflect radiant infrared (IR) energy, thus tending to keep radiant heat on the side of the glass where it originated, while letting the visible light pass through the window glass to the interior of the building. This results in more efficient windows, because radiant heat originating from indoors is reflected back inside -- making the building warmer in the winter, while infrared heat radiation from the Sun is reflected away -- keeping it cooler inside during the summer months. The latter is more useful in the context of Indian situation.

A) Pyrolytic Coatings

Actually, among two different types of Low-E coatings, i.e. "passive" Low-E coatings and "solar control" Low-E coatings, the former is manufactured using the pyrolytic process. The coating is applied to the glass ribbon while it is being produced on the 'float line'. The coating then "fuses" onto the hot glass surface, creating a strong bond, or a "hard-coat" that is very durable during fabrication. For very cold climates, particularly in the winter months, the passive Low-E coatings are good → as they allow some of the Sun's short-wave IR energy to pass through, which helps in heating the building during the winter, but they still reflect the interior long-wave heat energy back inside.

The pyrolytic method involves deposition of fluorinated tin oxide (SnO2: F) at high temperatures. A typical pyrolytic coating is a metallic oxide (most commonly tin oxide with some additives), which is bonded to the glass while it is in a semi-molten state. The process by which the coating is applied to the glass surface is called "chemical vapour deposition" or CVD, which is extensively used in the field of 'coating technology'. This technique gives rise to a "baked-on surface layer" that is quite hard and thus very durable. This is the reason why pyrolytic Low-E coating is sometimes referred to as "hard-coat Low-E". A pyrolytic coating can be ten to twenty times thicker than a sputtered coating, but it is still extremely thin. These coatings can be exposed to air and cleaned with traditional glass cleaning products and techniques without damaging the coating.

Due to their inherent chemical and mechanical durability, pyrolytic coatings may be used in monolithic applications, subject to manufacturers' approval. They are also used in multi-layer window systems, where there is air flow between the two glazed surfaces as well as with non-sealed glazed units. It can be generally said that pyrolytic Low-E coating is most commonly used in sealed insulating glass units with the Low-E surface that is facing the sealed 'air space'.

B) Sputtered Coating

The 'solar control' Low-E coatings are manufactured using this process – the coating is applied off-line to pre-cut glass in a vacuum chamber at room temperature. The method involves deposition of thin silver layers with anti-reflection layers. Sputtered coatings are multilayered (5 to 10 layers) coatings that typically consists of metals, metal oxides, and metal nitrides. These materials are deposited onto the glass or plastic film in a vacuum chamber with multiple deposition chambers in a process called "physical vapour deposition". Although these coatings range from five to possibly more than ten layers, the total thickness of a sputtered coating is significantly less than the thickness of a human hair. Sputtered coatings often use more than one layer of silver to achieve their 'heat reflecting' properties. As silver is an inherently soft material that is susceptible to corrosion, the silver layer(s) must be covered by other

materials that act as 'barrier layers' to minimize the effects of humidity and physical contact. In other words, silver-based films are environmentally unstable and must be enclosed in insulated glazing or an insulated glass unit (IG) to maintain their properties over time, i.e. stable.

Considering the coating quality, the sputtered coatings are described as "soft-coat Low-E", as they offered little resistance to chemical or mechanical attack. Over the past 25-30 years or so, while advances in material science and engineering have significantly improved the chemical and mechanical durability of some sputtered coatings, the glass industry continues to generically refer to sputter coated products as "soft-coat Low-E". The best performing 'solar control' coatings are ideal for mild to hot climates that are more dominated by the use of 'air-conditioning' in commercial buildings, particularly in warmer countries like India.

Most sputtered coatings are not sufficiently durable to be used in monolithic applications. However, when the coated surface is positioned facing the air space of a sealed insulating glass (IG) unit, the coating should last as long as the sealed glass unit. Sputtered coatings have emittance as low as 0.02, which are substantially lower than those for pyrolytic coatings. Therefore, this type of coating is relatively more effective in the design consideration of the buildings. Next, let us talk about certain useful 'performance parameters' for judging the quality of E-glass for buildings and some related but important aspects.

C) The Performance Parameters

After having explained the salient points about the two important methods of making E-glasses, it is quite pertinent to mention briefly about the performance parameters for E-glass. First let us start with different potential surfaces of interest. Low-E coatings are applied to the various surfaces of insulating glass (IG) units. In a standard double panel IG, there are four potential coating surfaces to which they can be applied: (a) the first surface faces outdoors, (b) the second and (c) the third surfaces face each other inside the insulating glass unit and are separated by an air-space and an insulating spacer, and finally (d) the fourth surface faces directly indoors, i.e. interior of the building.

Whether a Low-E coating is considered 'passive' or 'solar control', they offer improvements in performance numbers in terms of four main parameters. To measure the effectiveness of glass with Low-E coatings, the following terms are used:

1) U-Value is the measure of how much 'heat loss' is allowed for a given window design.

2) Visible Light Transmittance (VLT) is a rating of how much 'light could pass' through a window.

3) Solar Heat Gain Coefficient (SHGC) is the fraction of incident solar radiation permitted through a window, i.e. both directly transmitted and that is absorbed and re-radiated inward. The lower a window's SHGC, the less solar heat it transmits.

4) Light to Solar Gain (LSG) is the ratio between the window's SHGC and its VLT rating.

The following table shows how the coatings made by different methods measure up by minimizing the amount of UV and IR light that can pass through a glass window without compromising the amount of 'visible light' that is transmitted:

On retro-fitting, it should be noted that Low-solar-gain "Low-E coatings" on plastic films can also be applied to existing glass as a retrofit measure, thus reducing the SHGC of an existing clear glass considerably while maintaining a high visible transmittance and lower U-factor. Many buildings at present use different "tints", but these conventional tinted and reflective films will also reduce the SHGC but at the cost of lower visible transmittance. Reflective mirror-like metallic films that are often used in some new buildings could also decrease the U-factor, since the surface facing the room (i.e. interior) has a lower emittance than uncoated glass.

For a significant amount of solar radiation to pass through the window, conventional clear glazing is the 'choice', and in this case, heat from objects within the 'interior space' is re-radiated back into the glass → then from the glass to the outside of the window. For maximizing energy efficiency during under-heated periods, a glazing design would ideally allow the entire solar spectrum to pass through, but it would block the re-radiation of heat from the interior space. The first low-E coatings, intended mainly for residential applications, were designed to have a high SHGC and a high VLT to allow the maximum amount of Sun-light into the interior space, while reducing the U-factor significantly. A glazing designed to minimize summer heat gains, but allow for some day-lighting, would allow most visible light through, i.e. relatively higher VLT, but this design would make all other portions of the solar spectrum blocked, including UV and near-IR, as well as long-wave heat radiated from outside objects, such as pavements and adjacent buildings. These second-generation Low-E

Low-E: 1.25 cm air & 0.63 cm clear	U -Value	VLT	SHGC	LSG
Pyrolitic	0.35	64%	0.55	1.17
Sputtering (Double Silver)*	0.29	61%	0.34	1.87

**Triple-silver coating will have a better performance than double-silver coating.*

coatings still maintain a low U-factor, but are designed to reflect the solar near-IR, thus reducing the total SHGC while providing high levels of daylight transmission (i.e. higher VLT).

The beneficial solar gain is reduced by the 'Low-solar-gain' coatings that could be used to offset 'heating loads', but in most commercial buildings this is significantly outweighed by the 'solar control' benefits. It is common to apply Low-E coatings to both tinted and clear glass in many commercial buildings, Actually, the 'tint' lowers the VLT somewhat, but it contributes to 'solar heat gain' reduction and 'glare control'. Low-E coatings can be formulated to have a broad range of 'solar control' characteristics while maintaining a low U-factor.

D) Some Related Aspects

It is interesting to note that glass can be made with differing thermal emissivity, but this is not used for windows. Certain properties such as the iron content may be controlled, which changes the thermal emissivity properties of glass. This "naturally" low thermal emissivity is found in some formulations of Borosilicate or Pyrex. Naturally Low-E glass does not have the property of reflecting near-IR (NIR) /thermal radiation; instead, this type of glass has higher NIR transmission, leading to undesirable heat loss (or gain) in a building window.

Having explained different aspects of E-glass, it must be added that there is also a certain degree of criticism on the usage of E-glass. Since energy-efficient windows reflect much more Sun-light than standard glass windows, when these windows are somewhat concave they can focus Sun-light and cause damage. The damage to the sidings of homes and to automobiles has been reported in 'news stories' **[6,7]**. Low E-glass windows may also block radio frequency signals. Then, the buildings without distributed antenna systems may suffer degraded cell phone reception **[8]**. As 'smart' mobile phones are very much in use in both residential and commercial buildings that are increasing by the day in numbers, the need for further development cannot be denied.

Here, it is useful to mention about the "Reflective Thermal Insulation" (RTI). It is typically fabricated from 'aluminium foil' with a variety of core materials such as low-density polyethylene foam, polyethylene bubbles, fiber-glass, or similar materials. However, each 'core material' shows its own set of benefits and drawbacks based on its ability to provide a "thermal break", "deaden sound", "absorb moisture", and finally "resist combustion" during a fire break-out. When we use 'aluminium foil' as the 'front material', the RTI can stop 97% of radiant heat transfer. Recently, some RTI manufacturers have switched to a "metalized polyethylene" as 'front material'. The long-term efficiency and durability of such facings are still not properly understood, and hence, there is a need for further development.

Further, the RTI can be installed in a variety of applications and locations including residential, agricultural, commercial, and industrial structures. Some common installations include house wraps, duct wraps, pipe wraps, under radiant floors, inside wall cavities, roof systems, attic systems and crawl spaces. Also, the RTI can be used as a stand-alone product in many other applications, but it can be used in 'combination systems' with mass insulation as well, where higher value of the reflectance is required.

CONCLUSIONS

As the building industry expands in terms of both volume and quality, there is an urge for energy saving as well as for smart buildings with the use of E-glass windows that are capable of reflecting undesirable wavelengths of the solar spectrum, while making the visible solar spectrum to enter into the interior space of the building. This gives us enough visibility and also more saving of electrical energy, which is good for the environment. It is needed in both residential and commercial segments, where its usage surely makes the value-addition meaningful. The definition of E-glass has been given in details. The methods of preparation have been briefly described with their benefits and drawbacks as well as in terms of performance parameters that should guide the user industry to select the right type of E-glass for the building industry. Some other related issues have also been discussed. There is a scope of not only expanding the market for the glass industry, but also there are immense possibilities of tailor-making thereby improving the market further ■

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NNPB: Less weight – less energy – less environmental impact

Mark Ziegler
Heye International

The results of many studies survey show us: Rising energy costs remain a key issue in the container glass industry. At the same time, environmental aspects become more and more important. This is why the NNPB technology (Narrow Neck Press & Blow) is still on a growth path. Mark Ziegler from Heye examines the critical success factors of this production technology.

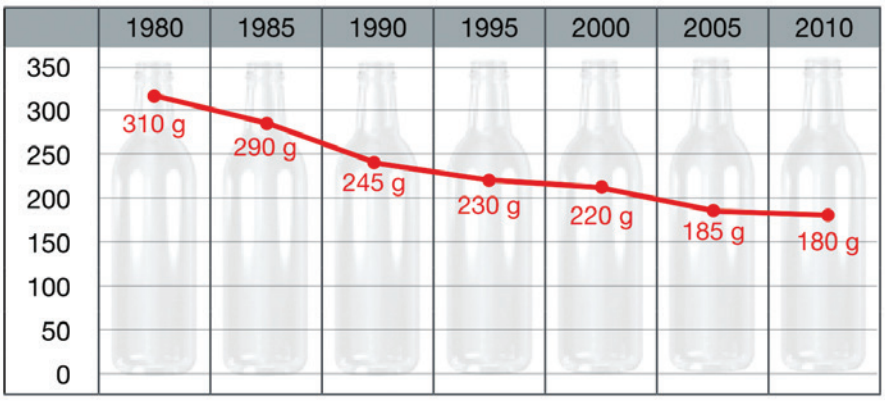
NNPB allows thinner and more equal wall thicknesses. Weight is reduced and in consequence energy- and raw material consumption as well. But NNPB has higher requirements to the glass quality, machine settings and the moulds. Monitoring and control of the production process is fundamental. The Heye Process Control, avoiding overpressed or unfilled finishes, is a key element. The Automatic Press Duration Control, allowing a constant wall thickness, is an important extension.

Obvious that modern NNPB production is more than just purchasing machinery. The larger portion is determined by expertise in procedures and the way how all the steps fit together. Only if all involved areas of the NNPB-Process are trained and successfully implemented, a pay back of all the investment is realised. Where is the advantage to invest money in new moulds and a new IS-Machine prepared for NNPB without well educated mould maintenance people who are damaging the new mould set by not knowing that there are new requirements to their work? Also for the maintenance of the variables it can be necessary to train the employees in the new quality standard for their work to be able to receive the required quality at the best possible speed from the machine.

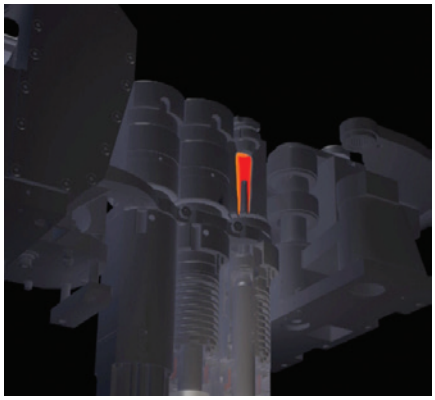
In consequence, Heye offers to its customers special NNPB knowledge-packages within the Technical Assistance Agreements (TAA).

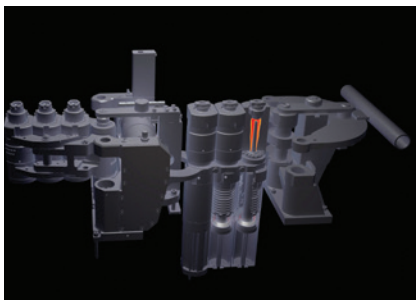
The NNPB modules contain:

- Training of operators in the NNPB-Process
- Machine settings
- Gob forming
- Correction of container defects
- Mould design and mould workshop
- Maintenance of variables



It is important that the production specialists from the supplier are glassmakers, speaking the same language as the glassmakers in the glass plants. **Trust and expertise** are the basis of all ■





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Some Perspectives of Software Solutions for Integrated Development of Glasses: A Case Study

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INTRODUCTION

There are multifaceted use of glasses in different forms and shapes. Although, raw materials and basic scientific process of making glass articles are same, the uses of glass articles, the manufacturing and business of glasses have a variant, depending of their application area. Many down line processes are also involved to give glasses a variety in type of product and area of application. Container glass manufacturing is different from flat glass manufacturing and it is different from table ware and decorative glasses. Glass industries are also different in terms of their production capacity, technology used; fully automatic, semi-automatic or labour intensive. The Indian glass industry is poised to grow at an unprecedented rate fuelled by the growth in sectors like real estate, infrastructure, retail, automotive, food and beverages. According to a study by ASSOCHAM Indian glass market is estimated to increase at a compound annual growth rate (CAGR) of 15 per cent. The glass consumption growth is expected in construction (10-12 per cent), automotive (20 per cent), consumer goods (15-20 per cent) and pharmaceuticals (15-18 per cent) sectors. The organised glass sector is dominated by large players like ASAHI Glass India Ltd, Hindustan National Glass & Industries Ltd, Piramal Glass, Saint-Gobain India, HSIL, Owens Corning, Triveni Glass, Gujarat Borosil etc. Growth drivers of the Glass Industry are:

- Increasing population and per capita usage of glass
- Green Building Concept
- Real Estate Sector boom
- Automotive Industry
- Solar Energy Glass demand
- Packaging Industry

Challenges faced by the glass industries are:

- Increasing prices of the raw materials
- Facing stiff competition from international particularly Chinese Products
- India exhibits low glass consumption in comparison to other countries
- Growing alternatives for glass affecting its growth.

The glass industry is facing tough competition from alternative medium. The latest challenge being faced by Indian glass manufacturer is increasing prices of the raw material which is an important component in the process of glass manufacturing. The increase in the price of raw materials is affecting the bottom line of the glass manufacturing companies. The use of glass is of critical importance in the present day when deteriorating environmental conditions have set alarm bells ringing for protection of environment in the interest of human health and wellbeing. There is an urgent need for preservation and improvement of environment. Glass industries are experiencing pressure not only for competition among themselves with in the country and outside, but also for maintenance of quality of the products at minimum cost, innovation in design and addressing the government regulations regarding environment.

During the last few years I have visited

Asahi India and Gujarat Guardian float glass plants along with a few container and bangle glass manufacturing units at Firozabad (Uttar Pradesh). In recent years large variation of in use and application of glass is being observed. To be successful in the glass business it is very important that proper market assessments are made at regular interval and quick decisions are made for strategic changes in the production line. In this endeavour, large scale analysis of data and calculated predictions are very much necessary. Computers and software solutions may be very much helpful in this direction. It has been observed that in large scale glass industries computers and softwares are being used for process control in manufacturing section and for management of finance and human resource in administration section. Computer usage is very little in medium and small scale sector. During year 2013-14, I assigned a project to our two undergraduate students Ms. Sakchhi Srivastava and Mr. Harish Ved to conduct a study on software solutions for Indian Glass Industry. AIS management was kind enough to allow them to have a tour of their Roorkee plant and to get a first-hand information regarding different operations and software requirement of a modern and advanced glass manufacturing plant. After their one day tour (September 13, 2013) they have done an extensive study for development of ERP software solution for glass Industry in particular for float glass industry. The present article is based on their extensive work, which may open up a new area of academic research and development in support for glass Industry. Supervisory contributions from Prof. K. K. Shukla, Department of Computer Science and Engineering, Indian Institute of Technology is highly acknowledged.

GLASS MANUFACTURING PROCESS

Float glass manufacturing process involves procurement of raw material in required quality with known quality. There is concern for iron content in raw material since it affects the transparency, tint and colour of glasses. After mixing the raw materials along with cullet in automated batch house, it is transferred to glass melting tank furnace. In glass tank furnace constituent raw material react and melt. Molten glass is refined, homogenized and conditioned before it is transferred to float tank. In float tank operation the glass is converted into a flat ribbon of required uniform thickness with good surface quality. Solidified ribbon is transferred to annealing furnace for stress removal. Continuous glass ribbon coming out of annealing furnace is inspected for any defect, coated for protection of surface finish and finally cut and sorted for marketing or subsequent down line operations. Down line operations depend on application and use of glasses. Toughened, mirror, insulated, automobile and solar glasses have different down line operations. Major factors of float glass manufacture are fuel efficiency of tank furnace, regenerators and float glass tank along with refining, homogenization (i.e. controlling defects), colour, tint and flatness of glasses. Other major concerns are reducing change over losses from one tint to other and control of effect of changes in raw materials on the working of glass tank furnace and characteristics of glasses.

ENTERPRISE RESOURCE PLANNING (ERP) SOFTWARE SYSTEMS

Organizations are under constant pressure from customers, shareholders, and suppliers to continuously improve upon the operations for manufacturing and better quality products, quickly and efficiently. Competing in a dynamic environment and meeting global challenges requires agility. Successful companies must be able to respond quickly and cost-effectively to change. The change could be of any type; shift in customer demands and supply chain partners, modifications to a business model or business process, business expansion and regulatory pressures imposed by financial markets, industrial groups, and government bodies. Organizations need to convert their industries into responsive, demand-driven, profit making enterprises by optimizing their operations. Their competitive advantage and ultimate survival depend on the use of extended information system applications and/or technology. The ERP is an industry-driven software system, which is commonly used by businesses organizations and industries as a practical solution to achieve an integrated enterprise information system, which facilitates the smooth flow of common functional information. ERP software is usually used for integrated applications to store and manage data at every stage of business, including: (i) product planning, (ii) cost and development, (iii) manufacturing (iv) marketing and sales, (v) inventory management and (vi) shipping and payments. ERP provides an integrated real-time view of core business processes, using common databases maintained by a database management system. ERP systems track business resources; cash, raw materials, production capacity and the status of business commitments: orders, purchase orders, and payroll etc. These applications make up the system to share data across the various departments

(manufacturing, purchasing, sales, accounting, etc.), who entered the data. ERP facilitates information flow between all business functions, and manages connections to outside stakeholders. One of the popular topics in the ERP implementation is to identify or develop "Critical Success Factors". The idea is that there are some important factors, which determine the success or failure of an ERP implementation. In information systems implementation research, there has been a lot of attention given to measuring success in implementation and finding which factors of information systems are critical to success.

OpenERP

There are some ERP software available for glass industries, however, some of these systems are known to be painful to implement and are very expensive. We worked for the development of OpenERP system for glass industry. OpenERP is an open source enterprise resource planning (ERP) software actively programmed, supported, and organized by OpenERP. OpenERP is an open source alternative to SAP ERP, Oracle E-Business Suite, Microsoft Dynamics, Netsuite, Adempiere, Compiere, OFBiz, Openbravo, and other enterprise resource planning softwares. OpenERP is licensed under the terms of the AGPL license. OpenERP is very flexible, incredibly easy to use and designed to fit one's own process. OpenERP's success is based on 6 main advantages; these are user-friendly, affordable, flexible, modular, web-based and easy to implement. The development processes of Open Source Software provide a new way of cutting cost while maintaining quality. This can make an ERP system, which may be fully available to small and medium enterprises. Open source software makes it possible to greatly reduce development costs by aggressive reuse of open source software libraries; to eliminate intermediaries (the distributors), with all of their expensive sales overhead; to cut out selling costs by free publication of the software; and to considerably reduce the marketing overhead.

OpenERP uses a Service Oriented Architecture (Figure 1) as a software architecture design pattern. Service oriented architecture (SOA) is a software design and software architecture design pattern, which is based on discrete pieces of software providing application functionality as services to other applications. This is known as service orientation. It is independent of any vendor, product or technology. A service is a self-contained unit of functionality. Services can be combined by other software applications to provide the complete functionality of a large software application. SOA makes it easy for computers connected over a network to cooperate. Every computer can run an arbitrary number of services, and each service is built in a way that ensures that the service can exchange information with any other service in the network without human interaction and without the need to make changes to the underlying program itself.

OpenERP includes large number of modules and features: these include sales management, purchase management, expense management, point of Sale, customer relationship management, project management, warehouse management, manufacturing, manufacturing resource planning, accounting and finance, asset management, human resource management, knowledge and document management etc.

MODULE DEVELOPMENT

Django is a free and open source web application framework, written in Python, which follows the model view controller architectural pattern. It is maintained by the Django Software Foundation (DSF), an independent and non-profit organization. Django's primary goal is to ease the creation of complex, database driven websites. Django emphasizes reusability and "pluggability" of components ensuring rapid development and the principle of don't repeat oneself.

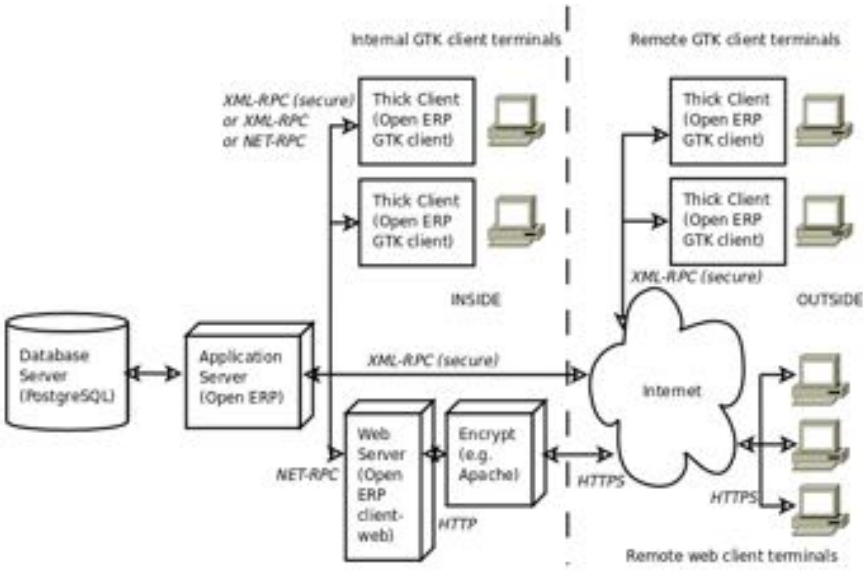

Figure 1 : OpenERP Architecture

Python is used throughout, even for settings, files and data models. Django also provides an optional administrative create, read, update and delete interface that is generated dynamically through introspection and configured via admin models. Django modules are dependent on placement of files inside the module root folder. An OpenERP module (Figure 2) can contain the following elements:

1. **Business object:** declared as Python classes extending the class osv.model, the persistence of these resource is completely managed by OpenERP's ORM
2. **Data:** XML/CSV files with meta-data (views and workflows declaration), configuration data (modules parametrization) and demo data (optional but recommended for testing)
3. **Reports:** RML (XML format). HTML/MAKO or OpenOffice report templates, to be merged with any kind of business data, and generate HTML, ODT or PDF reports

Each module is contained in its own directory within either the server/bin/add-ons directory or in another directory of add-ons, configured in server installation. To create a new module for example the 'OpenAcademy' module, the following steps are required:

- create a open academy sub-directory in the source/add-ons directory
- create the module import file __init__.py
- create the module manifest file __openerp__.py
- create Python files containing objects
- create .xml files holding module data such as views, menu entries or demo data
- optionally create reports or workflows

Object: All OpenERP resources are objects including Metadata. Object names are hierarchical. Generally, the first word is the name of the module. The objects are declared in python by subclassing osv.model. Object relational mapping (ORM) in computer science is a programming technique for converting data between incompatible type systems. This creates, a "virtual object database" that can be used from within the programming language. The ORM of OpenERP is constructed over PostgreSQL. It is thus possible to query the object used by OpenERP using the object interface (ORM) or by directly using SQL statements. But it is dangerous to write or read directly in the PostgreSQL database, as one can shortcut important steps like constraints checking or workflow modification.

XML Files: XML files located in the module directory are used to initialize or update the database when the module is installed or updated. They are used for many purposes i.e. initialization and demonstration, data declaration, views declaration, reports declaration, and workflows declaration.

Views: Views represent the objects on the client side. They indicate to the client how to lay out the data coming from the objects on the screen. There are two types of views; (i) form views and (ii) tree views. Lists are simply a particular case of tree views. A same object may have several views. For example, the products have several views according to the product variants. Views are described in XML. If no view has been defined for an object, the object is able to generate a view to represent itself. This can limit the developer's work but results in less ergonomic views. The design of new objects is restricted to the minimum: create the objects and optionally create the views to represent them.

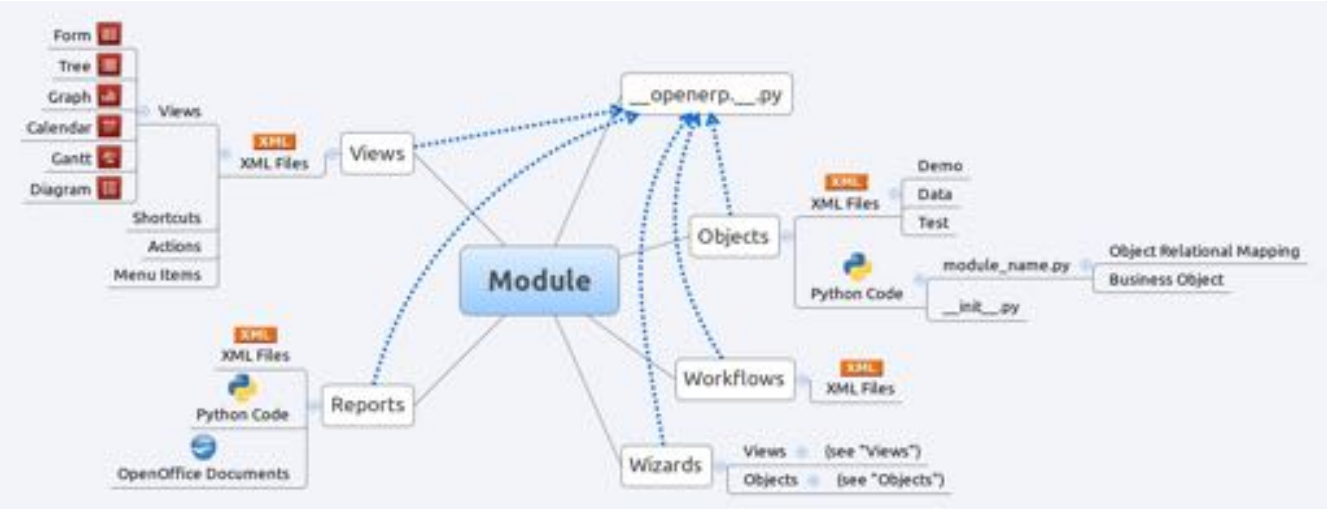

Figure 2 : OpenERP Module

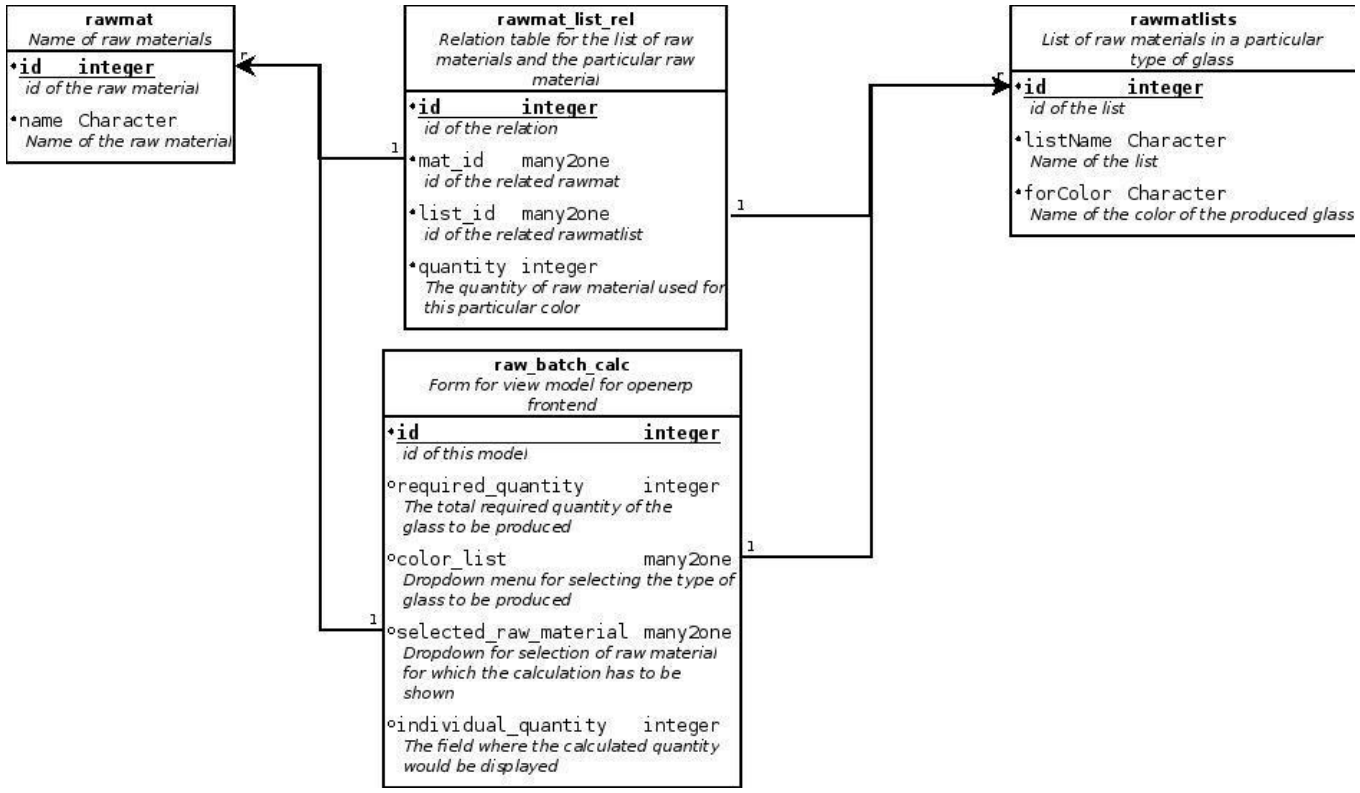

Figure 3 : Database structure for batch calculation of glass

Reports: OpenERP uses a flexible and powerful reporting system. Reports are generated either in PDF or in HTML. Reports are designed on the principle of separation between the data layer and the presentation layer.

Workflow: The objects and the views allow one to define new forms very simply, lists/trees and interactions between them. But that is not enough, one must define the dynamics of these objects. The dynamics between objects is known as workflow.

Under the present project a module is developed for batch calculation for OpenERP. The developed float glass batch calculation module is named '**float_glass'**. The root folder for the 'float glass' module consists of 4 files;

1. Python import file: __init__.py,
2. Manifest file: __openerp__.py, :
3. models file: float_glass.py and
4. XML file: float_glass_lists.xml.

The python import file consists of only a single line 'import float_glass', which allows us to import root 'float_glass' module folder. The next file is '__ openerp__.py' which gives relevant information about the developed module. The module defines a new menu tab on the menu bar root named 'Float Glass' with priority. This would contain all the additional modules. The child element of this menu-tab is 'menu_float_root' which categories the current module. The further child elements are:

'menu_float_raw_material_lists' is the model which helps us decide and create new lists. Here raw material lists stands for a particular list made up for a particular colour of glass. For example, a list to make 'green' glass should contain silica, dolomite, soda ash, salt cake, chromium oxide as raw materials. Similarly, many lists can be made for each colour. **'menu_float_raw_materials'** lists the model which helps us create and define raw materials. Here raw materials are the materials with info attached to them. For example, a raw material defines a name such as 'silica' and can include a foreign key to supplier's model. Hence, one record includes a single raw material. **'menu_float_raw_mat_ rel'** lists the model which defines the relationship between the lists and the raw materials. This has a one to many relationship with the lists table as well as the raw materials table. Thus the link, which list contains which raw material and also in what quantity. Thus, the quantity of a particular raw material in a particular list is defined here. **'menu_batch_calc'** lists; the model which defines the heart of this module. This model shows the calculation window where, if we select a list, will show the related raw materials, which, on selection, would show the calculated quantity required for that material according to the required glass quantity. **'view_ batch_calc'** shows the model that this field describes. The view is defined by a short xml file form by the name **'Calculations'**. The fields defined by this view are; required quantity, colour list, selected raw materials and individual quantity.

There are on change events in this model. These are; actions triggered by selecting a list and the selecting a raw material respectively. The working principle is that as the user selects a list from the dropdown menu, "the type of glass that has to be manufactured", the raw materials required for the manufacture of that particular glass are populated in the dropdown menu of the raw materials field. On selecting the raw material from that dropdown menu, the calculated batch quantity to manufacture the specified amount of glass is displayed in the "individual quantity' field. The database structure of the module is as given in the Figure 3. (Page 45) 'on change batch quantity' and 'on change raw material' are method fields, which are to be called as view functions. 'required quantity' is an integer field, which defines the amount of total glass of a particular type that is to be prepared. 'colour list' is a many to one field. This gives the correlation to the type of glass that is to be manufactured. 'selected raw material' field gives a list of raw materials in a particular list used for manufacturing a particular type of glass.

PROGRAMME EVALUATION AND REVIEW TECHNIQUE (PERT) AND NETWORK THEORY

Programme Evaluation and Review Technique or PERT, as commonly known, is a sophisticated and relatively new tool used by management for project planning and control technique. PERT, through its flexibility, can be used to cover almost any facet of a project. It became as the hottest new technique in the Theory and Practice of management. For making effective decisions, management must have some pertinent and timely information: (i) What are the alternative courses of action? (ii) What is the cost of each alternative? (iii) What are the risks involved? (iv) When should the decision be taken? (v) What will be the result if the decision is delayed? The management cannot afford the increasing costs of idle equipment, manpower, and time in these hard days of cut-throat competition and they must control it through PERT or critical path method (CPM). There are the three elements of a project: (i) Operation, (ii) Resources and (iii) The conditions and the restrictions under which the work must be done. The project completion is difficult until and unless there is timely delivery of designs, materials, machines etc., by the outer agencies. The objective of PERT is to coordinate them because they may be conflicting in the master plan. For preparing the Master Model, the various jobs and their sequence of performance must be determined. This can be done by a network. PERT consists of a network which is defined as a graphical representation of a Project Plan, showing the inter-relationship of the various activities. Networks are also known as Arrow Diagrams. PERT is a tool of planning used in predicting the performance time and for evaluating uncertainties in programmes. The main objective of PERT is to find out how closely the actual plans follow the theoretical plans. In Project management, it is extremely essential that the right quantity of resources reaches the right site and at the right time so that project progress is not stopped because of the shortage of resources. But during planning, any factor may be overlooked and some uncertainties may happen. PERT technique attacks the uncertainties faced by the activities for meeting the predetermined schedules.

PERT is basically an adaptation of Network Theory. Network Analysis of a project consists of three simple steps: First, a model or network is developed covering all aspects of a business activity or project. This model is a detailed picture of what should happen, indicating schematically (by networks) as to how the project should develop. The second step in network analysis is to evaluate the plan or model to be certain that if the steps are followed, the probabilities are great that the end objective will be reached. Finally, the network is used to monitor or control the project as it proceeds. To achieve the above, the following steps are taken:

- Arrange the individual jobs of the project in a logical network
- Identify the critical jobs e.g. the activities which control the completion date of the overall project
- Allocate resources to the individual activities to optimize the performance of the whole system in terms of cost and time
- Supervise progress and re-

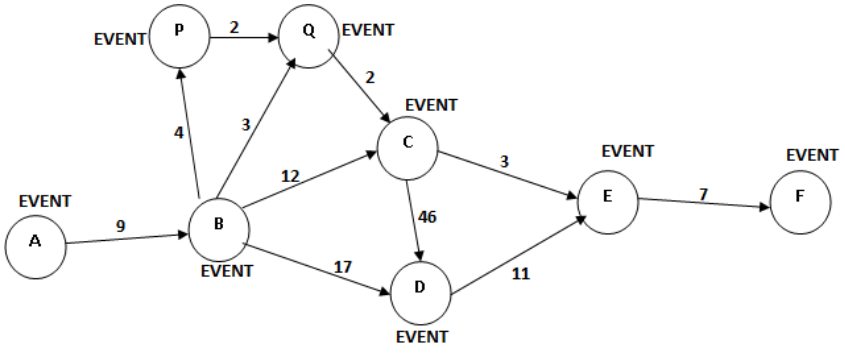

Figure 4: Schematic of Network

allocate resources as necessary to achieve the determined aims e.g., maintaining planned completion date or maintaining cost ceiling.

In this PERT diagram (Figure 4), no work can be started on any other event until B has occurred. After completion of event B, work can be started on the activities following event B and leading to event P, Q, C and D. Event C cannot occur until events A, B, P and Q have occurred, and so on so forth. Scheduling or Time Estimating consists of estimating the time required for each of the activities linking the events. One must know as to how long it will take to perform the activity leading from event A to event B, the time from B to C, and so on. These time values for projects must be estimated by those people who are most familiar with the activities. The intention is to get a real time required for each activity. The range provides a measure of uncertainty associated with the actual time required to perform the activity sometimes in future.

Critical Path in a network (Figure 5) is that sequence of interconnected events and activities which will require the longest time between the start and the completion of the network. Thus the critical path is the longest time path through the network using the expected time values for each activity as a guide.

In the above chart, the longest time path and therefore, the Critical Path is indicated by bold lines. The reason why this is called the critical path is that any delay in completing the activities along this path will delay the completion of the project. Some of the other activities not on the critical path, if delayed may not affect the overall time of the project. Three values are estimated; (i) the most optimistic time, i.e., the shortest time, it could possibly take to perform the activity, (ii) the most pessimistic time, i.e., the longest probable time that it will take and (iii) the most likely time, i.e., the time it will probably take to perform the activity. Management is often interested in knowing the cost of shortening period of different event or activity. By providing time and cost, it may help management to better utilize its manpower, materials and machines. But before making a decision, management would like to know the cost of such changes of advancing delivery. Adding cost figures to the time figures developed for the network can be done without much difficulty provided the firm has a sound cost-accounting system. These computations must cover direct costs of labour and materials, etc, as well as overhead charges, fringe benefits, etc. PERT/cost (PERT with cost) indicates where management can accelerate a project and how much it will cost, in order to make way for subsequent work.

PERT/cost helps the management in evaluating alternative plans of action on both in time and in cost basis. For instance, if resources are transferred from one part of a network to the critical path, the extra cost of doing so as well as the time saved could be ascertained. PERT/cost also helps in planning the financial aspects of a large project and indicates the money requirements for the various portions of the project, and also the time when required. The total amount required for the project is also known. This will enable the management to borrow money in advance or to make arrangements well in time. PERT/cost also helps the management in measuring the accomplishments of the various managers of departments in meeting their schedule and cost estimates on the project. This method also enables the management to find out the future manpower requirements and costs which can be secured either through additional personnel or through overtimes.

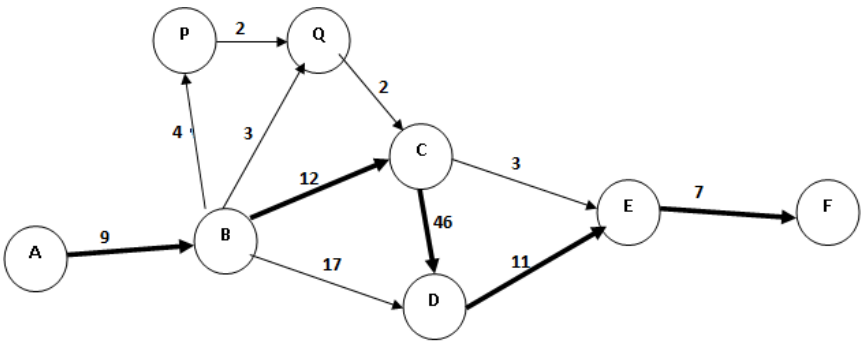

Figure 5 : Critical Path in Network

CONCLUSIONS

This article is an attempt to indicate the importance of software solutions in integrated development of glass industry particularly in Indian context. To the best of my knowledge, there is no prior work on ERP software for glass and ceramic industries, due to lack of relationship between academia and software industry with glass and ceramic industry. The study was under taken as a part of undergraduate research project under the supervision of the author. It was a trans-disciplinary activity with the involvement of Professor of Computer Science and Engineering. The project aims to be pioneer in this area. This project and article aims to generate awareness about this trans-disciplinary segment. Though, the project has carried out a lot of background study and addressed many software issues related to glass industry, a lot more work remains to

be done. It is because of the diverse nature of range of glass products for varied application and wide disparity in sizes of glass industries. There is urgent need to identify the Critical Success Factors (CSFs) for implementation in the Glass Industry. It can enable us to get more information about the customization and implementation needs of the industry. Once CSFs have been identified and analysed, ERPs can be implemented in a lot more successful manner with much less transition time.

This article indicate the benefits of using OpenERPs. Risks and integration costs are important barriers to all the advantages one gains from such systems. A few small and medium sized companies are not able to use ERPs. The development processes of Open Source Software, and the new business models provide a new way of resolving such cost and quality issues. Open source software makes it possible to greatly reduce development costs by aggressive reuse of open source software libraries and to cut out selling costs by free publication of the software. Since there is open interaction among thousands of contributors and partners working on the same project, the quality of the resulting software greatly benefits from the scrutiny. Because of OpenERP's modularity, collaborative developments in OpenERP have been cleanly integrated. Any company can choose from a large list of available functions and can build its own customized system by simply grouping and configuring the most suitable modules. Many modules for specific applications, which are urgently demanded can be developed. A module to identify and analyse the colours in tinted glasses need immediate attention.

ACKNOWLEDGEMENTS

The author would like to acknowledge the motivation, dedication and the meticulous effort of his students Ms. Sakchhi Srivastava and Mr. Harish Ved in bringing this project to a fruitful step forward. Support of AIS management for allowing our students to have a tour of their Roorkee plant for getting first-hand information regarding different operations and software requirement of a modern and advanced glass manufacturing plant is highly acknowledged. Lastly supervisory assistance from Prof. K. K. Shukla, Department of Computer Science and Engineering, IIT (BHU) Varanasi is acknowledged, which gave me a confidence for taking up this kind of interdisciplinary project ■

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काँच का इतिहास

प्रकृति में ऑब्सीडियन पाषाण पाया जाता है जो एक प्रकार का काँच है। यह ज्वालामुखी पहाड़ों से निकलता है और इसके टुकड़ों में तीव्र धार होती है। पाषाण युग में वाण के सिरे, भालों की नाकें एवं चाकू के फल इसी के बनाए जाते थे। धातु युग में इसी आब्सीडियन पाषाण से शृंगार की वस्तुएँ, जैसे दर्पण इत्यादि, बनाए गए।

किंवदंती के अनुसार, मनुष्य को काँच का पता तब चला जब कुछ व्यापारियों ने सीरिया में फ़ीनीशिया के समुद्र तट पर शोरों के ढेलों पर भोजन के पात्र चढ़ाए। अग्नि के प्रज्वलित होने पर उन्हें द्रवित काँच की धारा बहती हुई दिखाई दी। यह काँच बालू और शोरे के संयोग से बन गया था।

ऐतिहासिक दृष्टि से सर्वप्रथम बर्तनों पर काँच के समान चमक उत्पन्न करने की रीति का आविष्कार मेसोपोटामिया में ईसा से प्राय: 12,000 वर्ष पूर्व हुआ।

प्राचीनतम काँच साँचे में ढले हुए ताबीज़ के रूप में मिस्र में पाया गया है, जिसका निर्माण काल ईसा से 7,000 वर्ष पूर्व माना जाता था। ईसा से लगभग 1,200 वर्ष पूर्व, मिस्रवासियों ने खुले साँचों में काँच को दबाने का कार्य आरंभ किया और इस विधि से काँच की तश्तरियाँ, कटोरे आदि बनाए गए। ईसा के 1,550 वर्ष पूर्व से लेकर ईसा युग के आरंभ तक मिस्र काँच निर्माण का केंद्र बना रहा।

फुँकनी द्वारा तप्त काँच को फूँकने की क्रिया मानव का एक महान् आविष्कार था और इसका श्रेय भी फ़ीनीशिया वासियों को ही है। इस आविष्कार की अवधि ईसा से 320-20 वर्ष पूर्व है। इस आविष्कार द्वारा काँच के अनेक प्रकार के खोखले पात्र बनाए जाने लगे। वस्तुत: आजकल के काँच निर्माण के आधुनिक यंत्रों में भी इसी क्रिया का उपयोग किया जाता है।

काँच उद्योग का व्यापारिक विस्तार ईसा काल से आरंभ होता है। इटली के रोम तथा वेनिस प्रदेशों में इसका निर्माण चरम सीमा पर पहुँचा। अपनी आवश्यकताओं और वैज्ञानिक उन्नति के साथ प्रत्येक देश में विभिन्न गुणों के काँच के निर्माण में उन्नति होती गई। काँच उद्योग की आधुनिक उन्नति का बहुत कुछ श्रेय इंग्लैंड, फ्रांस, जर्मनी और संयुक्त राज्य अमरीका को है। उदाहरणत:, सन् 1557 ई. में सीस युक्त स्फटिक का लंदन में आविष्कार हुआ; सन् 1668 में पट्टि का काँच ढालने की विधि का पेरिस में आविष्कार हुआ; सन् 1880 में लेंस (लेंज़्ज़ा) आदि बनाने योग्य अनेक प्रकार के काँचों का आविष्कार जर्मनी में शाट एवं एवी द्वारा हुआ; 1879 में काँच बनाने के लिए पूर्ण स्वचालित यंत्र ओवेन का निर्माण हुआ; सन् 1915 में ऊष्मा प्रतिरोधक 'पाइरेक्स' काँच का निर्माण हुआ, जो तप्त करके ठंडे पानी में डुबा देने पर भी नहीं तड़कता; सन् 1928 में निरापद काँच (सेफ़्टीग्लास) का निर्माण हुआ जो चोट लगने पर चटख तो जाता है, परंतु उसके टुकड़े अलग होकर छटकते नहीं। यह मोटर कारों में लगाया जाता है; 1931 ई. में काँच के धागों और वस्त्रों का निर्माण हुआ; सन् 1902 में, संयुक्त राज्य अमरीका के पिट्सबर्ग नगर में और बेल्ज़ियम में 'लिबीओवेंस' और 'फ़ूरकाल्ट' प्रणालियों द्वारा चद्दरी काँचों का निर्माण होना आरंभ हुआ।

भारत में काँच

प्राचीन भारत में भी महाभारत, यजुर्वेद संहिता, रामायण और योगवाशिष्ठ में काँच शब्द का उपयोग कई जगह किया गया है। प्राचीन भारत में स्फटिक (Quartz) से बनी सामग्री, उत्तम वस्तु मानी जाती थी। भारत में कई प्रदेशों में प्राचीन काँच के टुकड़े प्राप्त हुए हैं। भारतीय काँच का विवरण वास्तव में 16वीं शब्दाब्दी से आरंभ होता है। उस समय यहाँ से अनिर्मित काँच बहुत अधिक मात्रा में यूरोप और उत्तरी इटली को निर्यात किया जाता था; यहाँ तक कि काँच निर्माण के लिए रासायनिक पदार्थ भी वेनिस भेजे जाते थे। 19वीं शताब्दी में भारत के प्रत्येक प्रांत में काँच की चूड़ियों, शीशियों और खिलौनों का निर्माण होता था।

आधुनिक भारतीय काँच उद्योग सन् 1870 से आरंभ हुआ और सन् 1915 तक कितने ही काँच के कारखाने खोले गए, पर वे सब असफल रहे। प्रथम विश्व युद्ध में भारतीय काँच उद्योग को खूब प्रोत्साहन मिला। परंतु

युद्धोपरांत भारतीय बाजार काँच के विदेशी माल से भर गया, फलस्वरूप कई भारतीय कारखाने बंद हो गए। काँच उद्योग की जाँच और उन्नति के लिए उत्तर प्रदेश सरकार ने एक समिति का संगठन किया और उसकी संस्तुतियों को सरकार ने मान्यता दी। उसी समय से काँच उद्योग में तीव्रता के साथ उन्नति हो रही है और अब भारत में काँच की सब प्रकार की वस्तुओं का निर्माण आधुनिक ढंग से हो रहा है।

काँच निर्माण की विधियों के विकास की समय रेखा

1226 – "ब्रॉडशीट" (Broad Sheet) ससेक्स (Sussex) में सर्वप्रथम विकसित

1330 – "Crown Glass" first produced in Rouen, France. "Broad Sheet" also produced. Both were also supplied for export

1620 – "Blown Plate" first produced in London. Used for mirrors and coach plates

1678 – "Crown Glass" first produced in London. This process dominated until the 19th century

1688 – "Polished Plate" first produced in France (cast then hand polished)

1773 – "Polished Plate" adopted by English at Ravenshead. By 1800 a steam engine was used to carry out the grinding and polishing process

1834 – "Improved Cylinder Sheet" introduced by Robert Lucas Chance, based on a German process of partial remelting of cut glass cylinders. This type of glass was used to glaze The Crystal Palace of the Great Exhibition. The process was common until WW1.

1843 – An early form of "Float Glass" invented by Henry Bessemer, pouring glass onto liquid tin. Expensive and not a commercial success.

1847 – "Rolled Plate" introduced by James Hartley. This allowed a ribbed finish. This type of glass was often used for extensive glass roofs such as within railway stations

1888 – "Machine Rolled" glass introduced allowing patterns to be introduced

1898 – "Wired Cast" glass invented by Pilkington for use where safety or security was an issue. This is commonly given the misnomer "Georgian Wired Glass" but greatly post-dates the Georgian era

1903 – "Machine Drawn Cylinder" technique invented in USA. Manufactured under licence in UK by Pilkington from 1910 until 1933

1913 – "Flat Drawn Sheet" technique developed in Belgium. First produced under licence in UK in 1919 in Kent

1923 – "Polished Plate" first appeared in UK. Commonly used for large panes such as on shopfronts

1938 – "Polished Plate" process improved by Pilkington, incorporating a double grinding process to give an improved quality of finish

1959 – "फ्लोट काँच (Float Glass) यूके के बाजार में आया।" ■

(Source : World Wide Web)

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Gold standard for safe food packaging

"Glass is 100% safe, an ideal food packaging material with respects to consumers' health and food safety" is the univocal conclusion of a scientific literature report on food packaging materials and their potential impact on human health. The report was carried out by Dieter Schrenk, Professor of Food Chemistry and Toxicology at the University of Kaiserslautern in Germany.

In his report, Professor Schrenk refers to glass as the material that allows for the least amount of interaction between the packaging and its content. It is made from raw materials abundant in nature (ie sodium/potassium silicate). Glass is highly inert, which means that the release from glass into food and drink is marginal and toxicologically irrelevant.

The report is likewise unambiguous in concluding that health risks assessment is however an ongoing challenge for other food packaging materials like plastic polymers, paper and cardboard, as well as metals.

Some verbal examples are made to draw the picture: Additives like plastifiers, antioxidants and other chemical substances are needed to make plastics more impermeable to external agents such as oxygen and light. Parts of these chemical substances migrate into the food and drink products; besides the widely used bisphenol A, phthalates are found in products in contact with plastics. They have been identified as the cause of endocrine function disruption in the human being.

Similarly, a broad range of chemicals is needed to convert paper and cardboard, generally considered as natural materials, in packaging solutions. Plastic polymer coatings, UV protectants, solvents and chemicals are used in pulp and paper production, while printing inks and other contaminants originate from the increasing use of recycled paper. To the same extent, most of the metal packaging solutions have to be coated inside with plastics to avoid direct contact with food (stainless steel would be a viable solutions if production costs were viable).

Table 1 provides an extensive but not exhaustive overview of substances migrating from Food Packaging Materials (FPM) [1].

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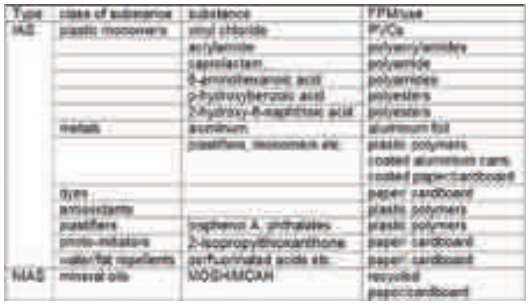

Table 1: Overview over substances migrating from FPM (Professor Schrenk report).

There is still a lot that remains unknown with regard to the potential for release and migration of chemical components from packaging into food and drinks. The worrying doubt is that the danger of already identified substances has not yet been fully assessed. No less worrying is the fear that other substances will surface and become part of this overview. In his report, Professor Schrenk recommends avoiding lowering the guard. On the contrary, more research is needed into the matter to effectively understand what the consequences are for humans. Meanwhile, in this context of uncertainty, he clearly votes for glass as the safest packaging option. And he is not the only one.

According to Europe-wide research carried out in 2014 [2], 87% of European consumers recommend glass as the best packaging option to their families and friends. The majority (66%) are highly worried about food contamination or migration of harmful chemicals from packaging into food products and they consider glass as the safest food and beverage packaging material. This is a key driver in choosing glass packaging; while in 2010 the health aspect was a reason for 48% of consumers to choose glass packaging, in 2014 61% of consumers said so.

Professor Schrenk's report, as well as the InSites research were published last April in the framework on the new Friends of Glass 'Look Beyond the Label' campaign. Check out www.friendsofglass.com for more information. ■

REFERENCES

1. 'Literature report on food packaging materials and their potential impact on human health', Professor Dieter Schrenk, April 2014, http://news.friendsofglass.com
2. InSites Research, April 2014, http://news.friendsofglass.com

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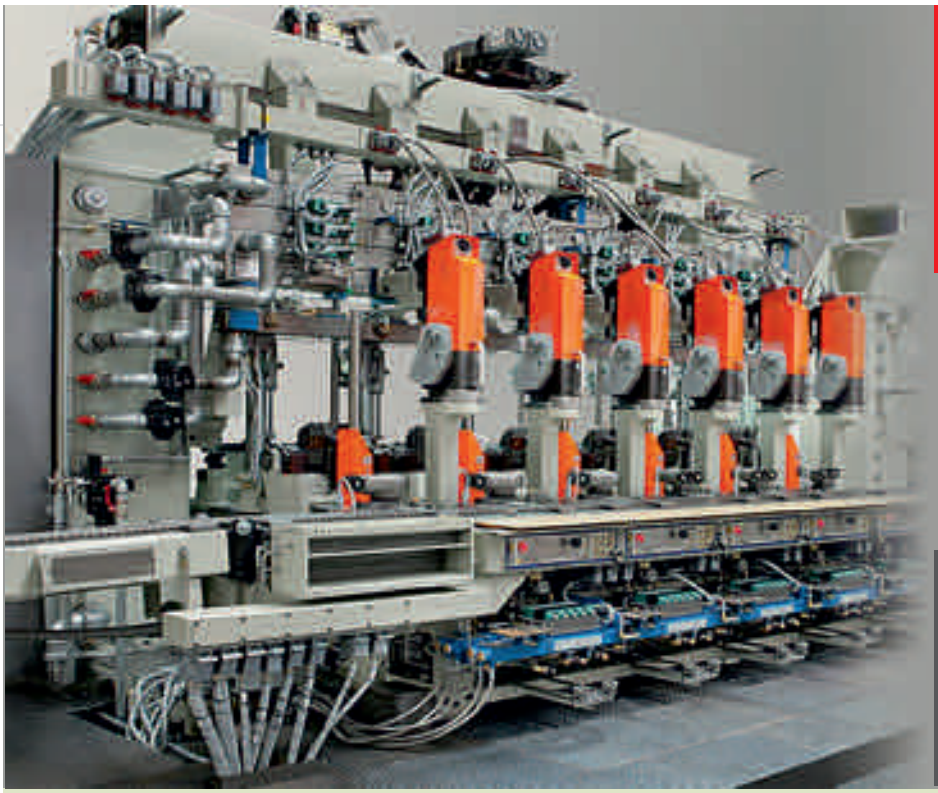

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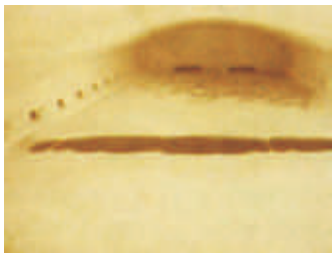







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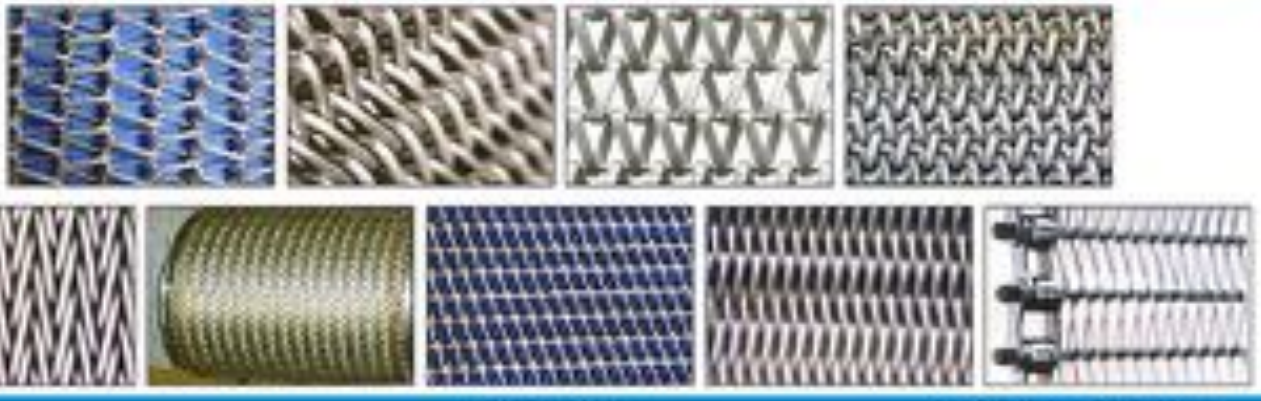

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