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AIGMF

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THE QUARTERLY JOURNAL OF THE ALL INDIA GLASS MANUFACTURERS' FEDERATION

Under the guidance of our visionary chairman ***Shri Devi Charan Agarwal*** what started as a humble glass manufacturing unit in the year 1989 has today evolved into a conglomerate of many companies under it's banner.

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AIGMF
MEMBER ASSOCIATIONS

UP GLASS MANUFACTURERS' SYNDICATE (UPGMS)

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1st Vice President -Raj Kumar Mittal
2nd Vice President- Dharmendra Mohan Gupta
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President - J P Kasera
Vice President - S C Vishwakarma
Secretary & Treasurer - D S Purushothaman

SOUTH INDIA GLASS MANUFACTURERS' ASSOCIATION (SIGMA)

C/o AGI glaspac, Glass Factory Road, Off Motinagar, P B No. 1930, Sanathnagar, PO Hyderabad - 500018
President - Sandip Somany
Vice President - Arvind Nandgopal
Hon. Secretary - Prashant Somany

WESTERN INDIA GLASS MANUFACTURERS' ASSOCIATION (WIGMA)

C/o Pragati Glass Works (P) Ltd. 111, Damji Shamji Industrial Complex, 9, LBS Marg, Kurla (W), Mumbai – 400 070
President – H.R. Bhandari
Hon. Secretary – G.K. Sarda

EASTERN INDIA GLASS MANUFACTURERS' ASSOCIATION (EIGMA)

C/o Ashoke Enamel & Glass Works (P) Ltd. 34-A, Metcalfe Street, 1st Floor, Kolkata - 700013
President - Dinesh Jhunjhunwala
Hon. Secretary - Pradeep Jhunjhunwala

Kanch

Quarterly Journal of
THE ALL INDIA GLASS MANUFACTURERS' FEDERATION

Vol. 4, No. 3, April - June 2011

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Editor MOHAN LALVANI

The All India Glass Manufacturers' Federation

Dear Readers,

January-March 2011 issue of KANCH was our 1st attempt to make KANCH broad based and to increase its circulation with introduction of e-edition and browsing of our updated website.

I am glad to inform members that our efforts have brought fruit and response received is very satisfying. Increase in circulation has helped AIGMF in establishing contacts with new companies including those from other parts of the globe. Some of these have shown interest for advertisement in KANCH. Enquires for memberships of the AIGMF have also been received.

It is because of publicity through this media that quite a few non-members registered themselves for Glass Recycling Seminar held in Hyderabad on June 29, 2011.

I invite readers to participate in our endeavor to increase readership of KANCH, increase in membership of the AIGMF and to contribute Glass News / Views and Technical / Informative articles, which could be published in KANCH. With member's cooperation, we hope to publish some data regarding exports / production of glass, glassware in the forthcoming issues. This will be of interest to all whether manufacturers/traders or others wanting to keep themselves abreast with developments in various industries.

With a view to give international exposure to the AIGMF Team, for the 1st time an AIGMF Delegation was sent to visit 22nd China International Glass Industrial Technical Exhibition (China Glass 2011) from 11-14 May, 2011 at Shanghai, People's Republic of China. The delegation was led by Mr. Suresh Chandra Bansal, Senior Vice-President, AIGMF and Managing Director, Adarsh Kanch Udyog Pvt. Ltd., Firozabad. A brief report on this has been given in this issue.

We hope to add more value to KANCH in the times to come.

Warm greetings and good wishes to one and all.

Mukul Somany
President

June 2011

and Vice Chairman and Managing Director
Hindustan National Glass and Industries Ltd.

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The All India Glass Manufacturers' Federation

The All India Glass Manufacturers' Federation was founded in 1944. The Federation is made up of five Regional Associations viz., Western India Glass Manufacturers' Association- Mumbai, Eastern India Glass Manufacturers' Association- Kolkata, U.P. Glass Manufacturers' Syndicate- Firozabad, Northern India Glass Manufacturers' Association- Bahadurgarh (Haryana) and South India Glass Manufacturers' Association- Chennai. The Federation was incorporated under the Companies Act, 1956 (No. 1 of 1956) as a Limited Company on 15.06.1970. The main aims & objects of the Federation are: -

a) To encourage, promote and develop the manufacture of glass articles of all kinds and to safeguard and protect the interests of glass industry and glassware business in India

b) To form a common link amongst Glass Manufactures' in India and thus develop a spirit of mutual help and co-operation with one another

c) To promote the study and research in Glass Technology

d) To consider all matters relating to the manufacture and marketing of glass articles in India and the question of export and import thereof

e) To devise ways and means for securing necessary supply of raw materials required for the manufacture of glass articles at comparatively lower prices and thus to decrease the cost of production and increase the national wealth

f) To collect necessary information and data and propagate it for the benefit of Glass Industry and trade in India

g) To make representations whenever necessary to the Union Government or any unit of the Union of India for the removal of difficulties that might hamper the trade of glass articles or for grant of special facilities for the glass industry

h) To draw Government or public attention to the difficulties in the way of Glass Industry and to solve other problems confronting it and to solicit their help and support through concerted action

i) To organize a united front on behalf of all glass manufacturers and thus strive to gain all those advantages which may not be possible through individual effort

All those engaged in the manufacture of glass and glass articles are enrolled as 'Ordinary' members of the AIGMF and those associated with the Glass Industry are enrolled as 'Affiliate' members of the Federation. Almost all glass manufacturers including many in the small scale sector are 'ordinary' members of the Federation. Articles of Association of the AIGMF were amended in September, 1992 to enroll foreign companies as Affiliate Members of the Federation.

AIGMF SECRETARIAT

AIGMF Glass Recycling Seminar

(A Report)

Along with meeting of the Executive Committee AIGMF Secretariat organized a 'Glass Recycling Seminar' on June 29, 2011 at Hotel Taj Krishna, Hyderabad. The seminar drew 51 participants from Industry and Institutions, which provided an ideal platform for fruitful discussions.

Mr. S C Bansal, Sr. Vice President, AIGMF welcomed delegates to the seminar and stressed on the importance of increasing use of cullet in glass manufacturing. In his opening remarks Mr. Mukul Somany, President, AIGMF stated that there is dire need to increase use of cullet in the batch. Seminar has been organized to arrive at some collective thinking as to how can this be achieved.

Audience in the Seminar

Seminar started with a presentation of Mr. Vinay Saran of Hindusthan National Glass & Inds. Ltd. He gave an overview of glass industry and elaborated on advantages of use of glass for end users. He stressed that in packaging; glass gives higher shelf life and retains purity/flavor of the contents. Its use in buildings, etc., gives a glassy look to the environment and reduces load on the mother earth.

While making his presentation Mr. Arun Kumar of AGI glaspac (An SBU of HSIL Ltd) stated that glass waste needs to be separated by chemical composition, depending on the end use and local processing capabilities. Municipal corporations and other local bodies need to be convinced that glass waste should not be allowed to go for land filling. Separate containers be kept to facilitate sorting of the waste. He also stressed on creating awareness among the public at large about the advantages of recycling glass. Support of NGOs will go a long way in increasing awareness about the usefulness of Glass Recycling.

In his presentation Mr. G K Sarda of Vitrum Glass Industries stated that 10 % increase in cullet in batch can save about 2 % fuel. Quality problem like seeds bubble can also be controlled by using more cullet, upto 20 %, more glass can be drawn. Unlike plastic, glass made from cullet is as good as that made by use of virgin raw material and with reduced emission of undesirable gasses. It was further stated that around 50 % cullet is used by glass industry in India, out of which 10-15 % is self-generated. He suggested that Industry should work closely with waste management departments of Municipal Corporations, local bodies for better collection of cullet. Cullet suppliers be prevailed upon to mechanize the process of sorting and washing.

Dr. S K Bhadra agreed with the speakers that more use of cullet will result in energy saving, lesser emissions of undesirable gasses. All steps therefore need to be taken for better collection, washing, etc. Pre-heating of cullet will give better results. He advocated use of photovoltaic systems and energy efficient LEDs particularly for solar panels, mobile and TV displays. He also gave an overview on transparent solar cell panels or energy efficient solar glass windows which derive energy as well as reduce internal energy requirement.

Some of the major companies/institutions who participated in the seminar include: AGI glaspac (An SBU of HSIL Ltd), Associated Ceramics Ltd., Central Glass and Ceramic Research Institute (CGCRI), Ceracon Engineers (P) Ltd., Fosbel India Pvt. Ltd., Glass and Frames, Govt. Institute of Ceramic Technology, Gudur, HNG & Inds. Ltd., Hoganas India Pvt Ltd., La Opala RG Ltd., Messe Dusseldorf India (P) Ltd., Piramal Glass Ltd., Planet Ceramica Pvt. Ltd., RIICO, Sibelco India Minerals Pvt Ltd., Sri Ganesh Bottles (P) Ltd., Tata Chemicals Ltd., Triveni Glass Ltd., Vitrum Glass Industries, Samyu Glass. We are thankful to Media representatives who joined us and reported in their news bulletins.

The interactive sessions / presentations can be viewed / downloaded from our website link: http://www.aigmf.com/past-events.php

Concluding the deliberations President AIGMF stressed that to meet growing demand the Glass Industry should aim to increase recycling to 60 % in the next five years by making intensive recycling efforts and reducing cost of production.

An event on Glass promotion is proposed to be organized on September 22, 2011 at New Delhi involving international participation citing their best practices and suggesting way forward for the benefit of Indian Glass Industry. For more details and participation, please send mail to info@aigmf.com

Membership of AIGMF

Membership

Members of the federation are classified into two categories; manufacturers of Primary Glass articles are enrolled as **Ordinary Members** of the Federation and suppliers to glass industry viz., suppliers of machinery, raw materials.

Consultants and others connected with glass industry are enrolled as **Affiliate members**

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

The membership forms can be downloaded from http://www.aigmf.com/membership.php Members of the Federation are enrolled on the recommendation of Zonal Associations viz.:

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

Admission Fee / Annual Subscription Affiliate Members:

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

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

Affiliate members from Countries other than India

i. The admission fee and annual subscription is US $ 100/- and US $ 200/- respectively.
ii. Applicants for enrollment for a period of five years may pay a consolidated amount of US $ 1000/- (including admission fee)

Ordinary Members:

Admission fee Rs.550/-.

Annual subscription:

i. Single Unit: Rs. 13,600/-
ii. More than one Unit: Rs. 50,000/-

कांच पुनरावर्तन संगोष्ठी

(एक रिपोर्ट)

AIGMF सचिवालय ने अपनी कार्यकारी समिति की बैठक के साथ 29 जून 2011, को कांच पुनर्चक्रण संगोष्ठी का आयोजन होटल ताज कृष्णा हैदराबाद में किया। इस संगोष्ठी में उद्योग जगत और अन्य संस्थाओं के 51 प्रतिभागियों ने भाग लिया।

श्री एस सी बंसल, वरिष्ठ उपाध्यक्ष, AIGMF, ने संगोष्ठी के प्रतिनिधियों का स्वागत करते हुए कहा कि कांच के निर्माण में कल्लेट के अधिक उपयोग पर महत्व दिया जाना चाहिए।

संगोष्ठी के दर्शक

अपने उद्घाटन भाषण में श्री मुकुल सोमानी, अध्यक्ष, AIGMF ने भी बैच में अधिकतम कल्लेट के उपयोग की आवश्यकता पर महत्व दिया।

हिंदुस्तान नेशनल ग्लास एंड इंडस्ट्रीज के श्री विनय सरन ने अपनी प्रस्तुति में कांच की जागरूकता के विषय पर भाषण दिया। उन्होंने कहा कि कांच पैकेजिंग उच्च शैल्फ जीवन, शुद्धता, सामग्री स्वाद बनाये रखता है। श्री सरन ने कहा कि भवनों में कांच का उपयोग, आदि, पर्यावरण के लिए लाभदायक होता है।

AGI glaspac के श्री अरुण कुमार ने कहा कि अनुपयोगी कांच रसायनिक संरचना से अलग किया जा सकता है, अतः नगर निगमों और अन्य स्थानीय निकायों को आश्वस्त करना चाहिए कि अनुपयोगी कांच का प्रयोग भूमि भरने के उपयोग में न हो। अतः कांच की छंटाई के लिए अलग कंटेनर रखे जाने चाहिए। उन्होंने कांच पुनरावर्तन के लाभ के बारे में जनता के बीच जागरूकता पैदा करने पर भी बल दिया। उन्होंने कहा कि गैरसरकारी संगठनों का समर्थन कांच पुनर्चक्रण के लिए बहुत आवश्यक है।

अपनी प्रस्तुति में Vitrum ग्लास इंडस्ट्रीज के श्री जी. के. शारदा ने कहा बैच में कल्लेट की 10% वृद्धि से 2% ईंधन बच सकता है। बीज और बुलबुले की गुणवत्ता समस्या भी अधिक कल्लेट के उपयोग करने से नियंत्रित की जा सकती है जिससे 20% अधिक कांच का उत्पादन किया जा सकता है। उन्होंने कहा कि कल्लेट या कच्चे

माल से बनाया गया नवीन कांच गुणवत्ता में एक सामान होता है। कल्लेट के उपयोग द्वारा अवांछनीय गैसों का कम उत्सर्जन होता है। उन्होंने आगे कहा कि लगभग 50% कल्लेट भारतीय कांच उद्योग में प्रयोग किया जाता है, जिसमें से 10–15% फैक्ट्रियों में स्वयं उत्पन्न होता है। उन्होंने सुझाव दिया कि उद्योग जगत को कल्लेट के बेहतर संग्रह के लिए स्थानीय नगर निगमों के साथ मिलकर काम करना चाहिए।

डा. एस. के. भद्रा ने वक्ताओं के साथ सहमति व्यक्त करते हुए कहा कि कल्लेट के अधिक उपयोग से न केवल ऊर्जा की बचत बल्कि अवांछनीय गैसों का उत्सर्जन भी कम होता है। अतः इस विषय में आवश्यक कदम उठाए जाने चाहिऐ। उन्होंने फोटोवोल्टिक प्रणालियों, सौरपैनल, मोबाइल और टीवी के लिए विशेष रूप से ऊर्जा कुशल एल ई डी के उपयोग के बारे में भाषण दिया। उन्होंने पारदर्शी सौर सैल पैनलों और सौर ऊर्जा कांच, जो ऊर्जा को उत्पन्न करने में सहायक होती है, पर विश्लेषण दिया।

कुछ प्रमुख कंपनियॉं और संस्थाएँ जिन्होंने संगोष्ठी में भाग लिया:

AGI glaspac (An SBU of HSIL Ltd), Associated Ceramics Ltd., Central Glass and Ceramic Research Institute (CGCRI), Ceracon Engineers (P) Ltd., Fosbel India Pvt. Ltd., Glass and Frames, Govt. Institute of Ceramic Technology, Gudur, HNG & Inds. Ltd., Hoganas India Pvt Ltd., La Opala RG Ltd., Messe Dusseldorf India P Ltd., Piramal Glass Ltd., Planet Ceramica Pvt. Ltd., RIICO, Sibelco India Minerals Pvt Ltd., Sri Ganesh Bottles (P) Ltd., Tata Chemicals Ltd., Triveni Glass Ltd., Vitrum Glass Industries and Samyu Glass.

AIGMF उन सभी मीडिया प्रतिनिधियों का अभारी है, जिन्होंने इस संगोष्ठी का प्रचार अपने समाचार बुलेटिनों में किया। संगोष्ठी की प्रस्तुतियाँ हमारी वेबसाइट के इस लिंक पर देखी जा सकती है:

http://www.aigmf.com/past-events.php

विचार – विमर्श के समापन पर AIGMF के अध्यक्ष ने बल दिया कि बढ़ती मांग को पूरा करने के लिए कांच उद्योग को रीसाइक्लिंग के लिए अधिकतम प्रयास करने चाहिए। उन्होंने कहा कि अगले पांच वर्षों में 60% तक रीसाइक्लिंग का प्रयास करना चाहिए।

कांच के अधिक उपयोग को बढ़ावा देने पर 22 सितंबर, 2011 को नई दिल्ली में एक संगोष्ठी आयोजित की जाएगी। जिसमे कांच समबंधित विभिन्न विषयों पर चर्चा की जाएगी।

अधिक विवरण और भागीदारी के लिए, कृपया info@aigmf.com पर लिखें।

AIGMF Executive Committee Meeting

(June 29, 2011, Hyderabad)

AIGMF Executive Committee Meeting was held on June 29, 2011 at Taj Krishna Hotel, Hyderabad. Interactive sessions / presentations made by conveners of sub committees were:

a) Raw Materials & Fuels Sub-Committee - (Particularly anti-dumping duty on soda ash) — Mr. GK Sarda, Empire Inds. Ltd., Vitrum Glass, Mumbai

b) Technical Sub-Committee – Upgradation of technical education by AIGMF Secretariat
Mr. Rama Mohana Rao, Principal, Government Institute of Ceramic Technology, Gudur, Andhra Pradesh (Special Invitee)

Discussions were held on qualitative improvement of technical education with Mr. Rao and Dr. S. K. Bhadra, Senior Scientist, Central Glass and Ceramic Research Institute (CGCRI), Kolkata. The purpose was that students passing out from technical institutes meet the requirements of the industry

c) Presentation by AIGMF Secretariat- Mr. Manohar Lal / Mr. Vinit Kapur

(Status update since March 2011 meeting and way forward)

d) Presentation by Mr. Vinay Saran, Hindusthan National Glass & Inds. Ltd., Kolkata on Life Cycle Analysis of Glass

Next AIGMF Executive Meeting will be held in New Delhi along with Annual General Meeting on September 22, 2011. For more details please write to info@aigmf.com

AIGMF Study Tour – 22nd China Glass

(A Report)

The AIGMF delegation visited 22nd China International Glass Industrial Technical Exhibition (China Glass 2011) from 11-14 May, 2011 at the Shanghai New International Expo Centre (SNIEC), Shanghai, People's Republic of China.

China Glass was supported by nationwide trade associations in China, including China Building materials Federation, China National Light Industry Council, China Association for Science and Technology, Chinese Architectural and Industrial Glass Association and China National Association for Glass Industry.

The delegation was led by Mr. Suresh Chandra Bansal, Senior Vice-President, AIGMF and Managing Director, Adarsh Kanch Udyog Pvt. Ltd., Firozabad.

Apart from members of the AIGMF, Manohar Lal, Secretary and Vinit Kapur, Joint Secretary, AIGMF were part of the delegation:

Mr. Suresh Chandra Bansal (Delegation Leader)	Adrash Kanch Udyog Pvt. Ltd., Firozabad
Mr. Sanjay Prakash Mittal	Farukhi Glass Inds., Firozabad
Mr. Lavu Kodanda Ramaiah	Farukhi Glass Inds., Firozabad
Mr. Ritesh Mittal	Meera Glass Inds., Firozabad
Mr. Balbir Singh	Mohan Mech (India), New Delhi
Mr. Premkumar Prakasdev Malhotra	Glacera Engineers, Pune
Mr. Sachin Vasant Kadave	BMT Machines Pvt Ltd, Pune
Mr. C J Kohli	BMT Machines Pvt Ltd, Pune
Mr. Manohar Lal	AIGMF, New Delhi
Mr. Vinit Kapur	AIGMF, New Delhi

Delegation went around the exhibition on May 11 & 12 and visited a factory on May 13, 2011.

Registration of visitors was extremely efficient. Inspite of big crowds there were no long queues and the whole process was orderly.

Many well-known companies came to display their latest machinery & equipment as also to showcase technological developments and development trends in relation to low-carbon emissions, energy-saving and new energy technologies. Besides, a number of technical symposia and seminars were organised concurrently with the show.

Some of the well-known glass machinery manufacturing companies such as Bottero, Lisec, Bystronic, Ctriulzi, etc., exhibited their latest design machines and products.

Large majority of exhibitors as also visitors were Chinese companies in the business of processing flat glass and manufacturing tools for glass processing industry.

Energy-saving products e.g. solar glass and insulating glass machinery were widely focused. The entire exhibition was very well covered under different segments which were spread out in 10 halls at the Shanghai New International Expo Centre (SNIEC), which is one of the most attractive venues worldwide.

Factory Visit: (Zhejiang Engineering Glass Co. Ltd., Yangxunqiao Township)

AIGMF delegation visited Zhejiang Engineering Glass Co. Ltd., located in Yangxunqiao Township, which is about 3 hours one way drive from Shanghai city on May 13, 2011.

The AIGMF delegation was taken around a float glass production line by factory representative. The delegation was shown entire process of float glass manufacturing starting from batch mixer, batch charger, melting tank, rolling, sizing, cutting to required size, annealing and packaging. The factory produces 0.4 to 1.9 mm of clear float glass.

We were also shown the plant where laminated/insulated/reflective glass is manufactured.

Members of the delegation were informed that the factory has 10 float glass production lines with aggregate daily melting capacity of 5000 tonnes.

AIGMF Meeting with Chinese Ceramic Society (main organisers of China Glass)

The Chinese Ceramic Society (CCS) is an academic, non-profit-making corporate and social organization for professionals engaged in the science and technology of inorganic nonmetallic materials.

We met Mr. Joe Zhou, Secretary General, Chinese Ceramic Society and had a detailed discussion with him. We were informed that the exhibition reached a new plateau with exhibition area of about 67,500 square meters. It attracted 761 exhibitors, including 205 international companies, coming from 26 countries: China, Germany, Italy, USA, Belgium, UK, France, Finland, the Netherlands, Switzerland, Sweden, Czechoslovakia, Austria, Australia, Israel, Japan, Korea, India, Indonesia, Singapore, Turkey, Saudi Arabia, Egypt, Jordan and Monaco.

CONCLUSION

On the whole visit to 22nd China Glass was educative and informative. Entire process starting from Registration/exhibition premises, transportation arrangements for general visitors, basic facilities i.e. food stalls, information kiosks, security, management by volunteers/paid staff, toilets, etc., were flawless.

In spite of large crowd particularly on the first day, the whole show was orderly and no chaos was seen. It was an eye opener to witness such an excellent arrangement inspite of large no., of visitors in the early hours.

All arrangements made by M/s Orbitz Corporate & Leisure Travels (I) Pvt. Ltd., were commended including that of local guide, translators (whenever required), sight-seeing, excellent variety of Indian vegetarian (including Gujarati) food during breakfast and dinner at Guamon hotel, which were part of the package offered by M/s Orbitz.

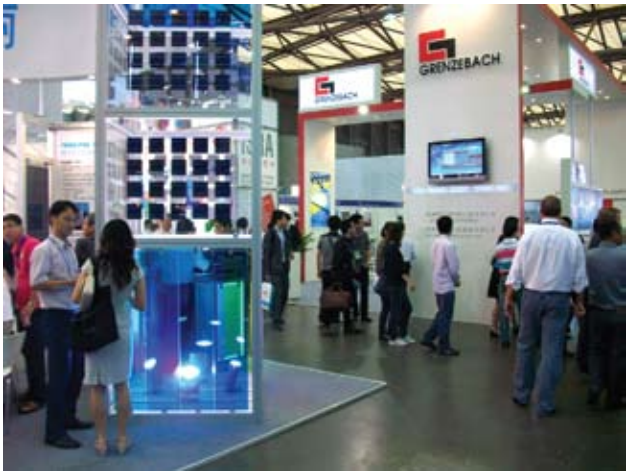
AIGMF प्रतिनिधि मंडल का 22वें चीन ग्लास का दौरा

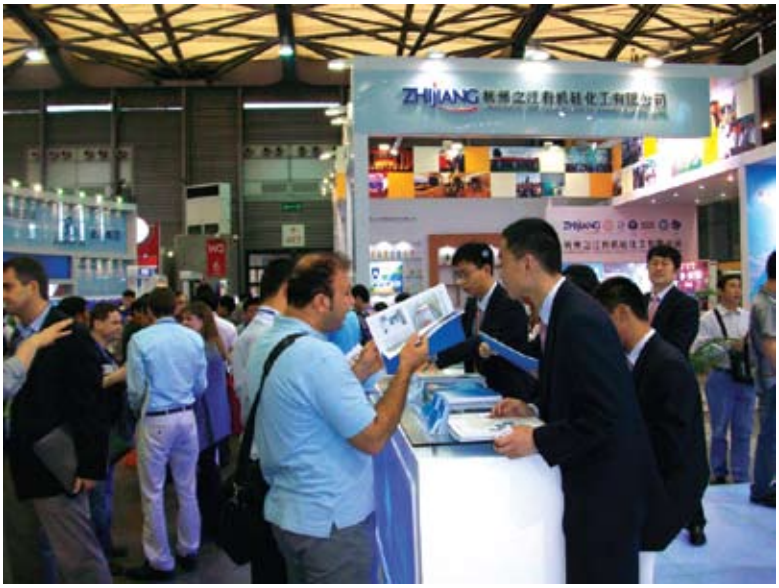
AIGMF प्रतिनिधि मंडल ने 22वें चीन अंतर्राष्ट्रीय कांच औद्योगिक तकनीकी प्रदर्शनी 2011 का दौरा किया। यह प्रदर्शनी शंघाई के नई अंतर्राष्ट्रीय केन्द्र (*SNIEC*) में 11–14 मई को आयोजित की गई।

22वाँ चीन ग्लास, चीन भवन निर्माण सामग्री संघ, चीन के राष्ट्रीय लाइट उद्योग परिषद, चीन एसोसिएशन के लिए विज्ञान और प्रौद्योगिकी, चीनी वास्तुकला और औद्योगिक कांच एसोसिएशन और कांच उद्योग के लिए चीन के राष्ट्रीय एसोसिएशन द्वारा समर्थित किया गया।

श्री सुरेश चन्द्र बंसल, वरिष्ठ उपाध्यक्ष AIGMF और प्रबंध निदेशक, आदर्श काँच उद्योग प्राइवेट लिमिटेड, फिरोजाबाद ने प्रतिनिधि मंडल का नेतृत्व किया।

AIGMF प्रतिनिधि मंडल के निम्नलिखित सदस्यों ने 22वें चीन अंतर्राष्ट्रीय कांच औद्योगिक तकनीकी प्रदर्शनी, 2011 का दौरा किया:





- श्री सुरेश चन्द्र बंसल, आदर्श काँच उद्योग प्रा. लिमिटेड, फिरोजाबाद
- श्री संजय प्रकाश, मित्तल फारुखी ग्लास इंडस्ट्रीज, फिरोजाबाद
- श्री लावू कोदंडा, रमैय्या फारुखी ग्लास इंडस्ट्रीज, फिरोजाबाद
- श्री रितेश मित्तल, मीरा ग्लास इंडस्ट्रीज, फिरोजाबाद
- श्री बलबीर सिंह, मोहनमेक (इंडिया), नई दिल्ली

आगंतुकों का पंजीकरण अत्यंत कुशल था। अधिक भीड़ के होने पर भी वहाँ कोई लंबी कतार और आव्यवस्थित प्रक्रिया नहीं थी।

प्रर्द्शनी में कई प्रसिद्ध कंपनियों ने अपनी नवीनतम मशीनरी और उपकरणों को प्रदर्शित किया। प्रदर्शित मशीनरीयों में कार्बन उत्सर्जन, ऊर्जा की बचत और नई ऊर्जा प्रौद्योगिकियों के संबंध में तकनीकी विकास और विकास के रुझान प्रमुख थी। इसके अतिरिक्त प्रदर्शनी में अनेक तकनीकी संगोष्ठियो का आयोजन किया गया।

- श्री प्रेम कुमार प्रकाशदेव मल्होत्रा, ग्लेसरा इंजीनियर्स, पुणे
- श्री सचिन वसंत कड़वे, बी एम टी मशीन प्राइवेट लिमिटेड, पुणे
- श्री जे सी कोहली, बी एम टी मशीन प्राइवेट लिमिटेड, पुणे
- श्री मनोहर लाल, AIGMF, नई दिल्ली
- श्री विनीत कपूर, AIGMF, नई दिल्ली

प्रतिनिधि मंडल ने 11 और 12 मई को प्रदर्शनी में भाग लिया और 13 मई को एक चीनी फ्लैट ग्लास फैक्ट्री का दौरा किया।

Bottero, Lisec, Bystronic, Ctriulzi आदि प्रसिद्ध कांच मशीनरी की विनिर्माण कंपनियों ने अपने नवीनतम मशीनों और उत्पादों का प्रदर्शन किया।

प्रदर्शकों का विशाल बहुमत चीनी कांच कंपनियों का था।

ऊर्जा की बचत उत्पाद, सौर कांच और कांच मशीनरी पर विशेष रूप से ध्यान केंद्रित किया गया।

पूरे प्रदर्शनी में कांच उद्योग के विभिन्न वर्गों को 10 विशाल हालो में आयोजित किया गया।

Zhejiang इंजीनियरिंग ग्लास कं लिमिटेड, फैक्ट्री का दौरा

AIGMF प्रतिनिधि मंडल ने Zhejiang इंजीनियरिंग ग्लास कं लिमिटेड का 13 मई, 2011 को दौरा किया। यह फैक्ट्री Yangxunqiao टाउनशिप में स्थित है, जो की शंघाई शहर से एक्सप्रेस वे द्वारा 3 घंटे की दूरी पर है।

प्रतिनिधि मंडल को कारखाने के प्रतिनिधि द्वारा एक फ्लोट ग्लास उत्पादन लाइन से अवगत कराया गया। प्रतिनिधि मंडल को फ्लोट ग्लास बैच मिक्सर, बैच चार्जर, रोलिंग, आवश्यक आकार को काटने, annealing और पैकेजिंग से शुरू निर्माण की पूरी प्रक्रिया से अवगत कराया गया। फैक्ट्री 0.4–1.9 मिमी के स्पष्ट फ्लोट ग्लास का उत्पादन करती है।

प्रतिनिधि मंडल के सदस्यों को सूचित किया गया कि फैक्ट्री में कुल 5000 टन दैनिक पिघलाने कि क्षमता के साथ 10 फ्लोट ग्लास उत्पादन लाइनें है।

AIGMF की चीनी सिरेमिक सोसायटी (चीन ग्लास के मुख्य आयोजक) के साथ बैठक:

चीनी सिरेमिक सोसायटी (सीसीएस) एकशैक्षिक, गैर लाभ कमाने वाली और प्रौद्योगिकी के क्षेत्र में लगे पेशेवरों के लिए कॉर्पोरेट और सामाजिक संगठन है।

श्री जो झोउ, महासचिव, चीनी सिरेमिक सोसायटी के साथ 22वें चीन ग्लास संम्बन्धित चर्चा की गई। श्री झोउ ने बताया कि प्रदर्शनी का कुलक्षेत्र 67,500 वर्गमीटर है। जिसमे 26 देशों (चीन, जर्मनी, इटली, अमेरिका, बेल्जियम, ब्रिटेन, फ्रांस, फिनलैंड, नीदरलैंड, स्विट्जरलैंड, स्वीडन, चेक, ऑस्ट्रिया, ऑस्ट्रेलिया, इसराइल, जापान, कोरिया, भारत, इंडोनेशिया, सिंगापुर, तुर्की, सऊदी अरब, मिस्र, जॉर्डन और मोनाको) से कुल 761 प्रदर्शकों और 205 अंतरराष्ट्रीय कंपनियो ने भाग लिया।

निष्कर्षः

22वाँ चीन ग्लास का दौरा शिक्षाप्रद और जानकारी पूर्ण था। आगंतुकों के लिए विशेष सार्वजनिक सुविधायें उपलब्ध थीं, जैसे कि पंजीकरण/प्रदर्शनी परिसर, सामान्य दर्शकों के लिए परिवहन व्यवस्था, भोजन स्टालों, सूचना कियोस्क, सुरक्षा, स्वयंसेवकों द्वारा प्रबंधन, शौचालय, आदि।

पहले दिन पर विशेष रूप से अधिक भीड़ होने के पश्चात पूरी तरह से शो अनुशासित था और आगंतुकों के लिए सम्पूर्ण व्यवस्थायें प्रशंसनीय थीं।

M/s Orbitz द्वारा की गई अनेक व्यवस्थायें जैसे की स्थानीय गाइड, अनुवादक, भ्रमण, शाकाहारी पकवान (गुजराती सहित) और Guamon होटल में रहने की व्यवस्था, कुल पैकेज का हिस्सा थे।

The use of recycled glass in new containers helps save energy. It helps in brick and ceramic manufacture, and it conserves raw materials, reduces energy consumption, and reduces the volume of waste sent to landfill

AIGMF Welcomes its New Member (April-June, 2011)

Company Name and Address	Product	Recommended by
Midas Autosoft Engineers Pvt. Ltd. 204 to 206, 2nd Floor, R Square, Opp. Atul Nagar, Warje, Pune - 411 052, Maharashtra (India) Telefax: +91 20 2523 5781 / 82 Contact person: Mr. Sunil Dalvi Manager (Projects) E-mail: projects@midasautosoft.com Web: http://www.midasautosoft.com	Engineering company in process automation and turnkey projects.	WIGMA

Energy costs drop about 2-3 % for every 10 % recycled glass used in the glass making process

AIGMF's Team Visit to Firozabad (Glass City of India)

(A Report)

Team consisting of Manohar Lal, Secretary, Vinit Kapur, Joint Secretary and Dilip Kumar, AIGMF office visited Firozabad on April 28, 2011. Apart from meeting with members of UPGMS, team visited some factories as well. Following points emerged from the discussion during these visits:

Pooja Glass Works Pvt. Ltd. – The factory is spread over an area of about 20 acres in Raja Ka Tal area Firozabad. Glass table and kitchenware including glass tumblers, bowls, jugs, pudding sets, in different shapes, sizes, colours and designs are manufactured in the factory by press and blow method. We went around the factory and saw the production process.

After going around the factory the team had a discussion with Mr. Devicharan Agrawal, Managing Director, Pooja Glass Works Pvt. Ltd. Mr. Agrawal started as an entrepreneur trading in glass and glassware in 1970. At a stage when he found that he could not get the requisite quantity/quality of the material to meet market requirements of the required products, he went into glass manufacturing. His unit named 'Pooja Glass' commenced production in 1990. Since then there has been no looking back and he is presently one of the leading manufacturers of glass table and kitchenware in India. He is quality conscious and company is exporting glass and glassware worth about Rs. 15 crores per annum. Mr. Agrawal informed that entire production technology is indigenous.

Mr. Agrawal further stated that this is a labour intensive industry and a large proportion of population in Firozabad, known as glass city of India, earns its living through Glass industry maybe directly or indirectly. There is a canteen which serves lunch etc., to staff at subsidized rates.

Supply of gas is the biggest problem faced by the industry to implement its expansion plans. Industry requested GAIL to increase supply of CNG to enable them to increase capacity. GAIL has responded with a proposal that industry may use as much CNG as required by them during a period of six months. Their quota will be increased to maximum amount used during this period. Mr. Agrawal mentioned that setting up of a glass manufacturing unit is not possible with in a period of 6 months. Thus many entrepreneurs may not be able to use this offer to meet their requirement for the intended expansion of their capacity. He also stated that increase in prices of natural gas is pushing up their cost of production which will make it difficult for them to compete with China and other countries, in the local as also international market.

Ganesh Beads Industries –Mr. B.K. Garg, Partner, Ganesh Beads Industries took AIGMF team round the factory. He explained that in this unit bangles in different sizes and colours are manufactured in pot furnace. Coloured Bangles are manufactured by either preparing coloured molten glass by adding the required colour in the batch itself or by using block glass of the required colour. Another method is to manufacture bangles in flint glass and spray required colours on these bangles. This is a well-managed unit having enough open space for heat to go out. Thus there was no excessive heat in the premises. Temperature in the factory was close to the temperature outside.

Akashwani Glass Works–Mr. Parsa stated that initially his forefathers started production of glass bangles in village Urmara and Jasrana, presently in district Firozabad. Bangles were manufactured through small furnaces called 'Chhal ki Bhatti' and 'Kara Chhal Bhatti'. Thereafter these were made through day tank furnace and pot furnace. Manufacture of bangles through Regenerative tank furnaces commenced in 1975. Luster polish was first of all done on bangles at their manufacturing stage in his father's factory M/s Sharda Glass Works during the year 1969. Consumption of Gas per tonne of glass melted in regenerative tank furnaces is much less than gas consumed in ordinary pot furnaces. Another important factor in favour of glass bangles industry is that capital employed per tonne of glass melted is much less than in other segments of glass industry.

Akashwani Glass works has come a long way by now. They have regenerative tank furnaces. During the manufacturing of glass bangles, the coloured molten glass is spread over on molten glass drawn from the pot/ regenerative furnace. In this way bangles may have two or more built in colours.

Meeting with UPGMS Members held on April 28, 2011

(at Hotel Aroma, Firozabad, Uttar Pradesh)

UP GLASS MANUFACTURERS' SYNDICATE (UPGMS)

President, UPGMS welcomed members of AIGMF team.

Secretary AIGMF stated that one of the important items of work assigned to AIGMF team by Mr. Mukul Somany, President, AIGMF is to explain to members the need for supply of data regarding purchased cullet used by them in the glass batch. This information is vital to impress upon the Government that by using cullet, glass industry is saving virgin raw materials, many of which are mineral based.

Energy used in glass manufacturing by using broken glass (cullet) is much less than when virgin raw materials are used. According to researches, every 10% increase in cullet components results in 17% reduction in carbon dioxide (CO_2) and 2.5% reduction in electricity and natural gas.

The current recycling level is 25-30% of the batch composition which has been achieved with the effort of the industry alone. The main reason for such low usage of cullet is its low availability due to unhygienic and illegal reuse of containers not designed for reuse particularly in segments like processed food, pharmaceutical and liquor. Quantum of carbon dioxide and other pollutant gasses produced by usage of furnace oil or other fuels are minimized by use of cullet. By giving this data we will try to convince the government that glass is an eco-friendly industry and should be given concessions in excise duty etc.

Another purpose is to inform UPGMS members about new look of KANCH, quarterly journal of the AIGMF, and introduction of Hindi pages therein. Joint Secretary, AIGMF stated that apart from advertisement support being given by members they are also requested to give articles/news regarding expansion etc., for publication in KANCH, both in Hindi and English. It was also mentioned that AIGMF website has been updated and members can advertise on website.

Many members of UPGMS protested against 1% central excise duty imposed in central budget 2011-12 on glass items produced by mouth blown process, which is highly labour intensive. Most of these items are in handicraft category and are meant for exports. Imposition of excise duty on such items is not justified.

Secretary, AIGMF thanked President, UPGMS for arranging this special meeting for discussion with AIGMF team.

Meeting ended with a vote of thanks to President.

Every metric ton (one long ton or 1,000 kg) of waste glass recycled into new items saves 315 kilograms of carbon dioxide from being released into the atmosphere during the creation of new glass

फिरोजाबाद कांच उद्योग का दौरा

AIGMF कार्यालय के सचिव, मनोहर लाल, संयुक्त सचिव, विनीत कपूर और दिलीप कुमार ने 28 अप्रैल, 2011 को फिरोजाबाद कांच उद्योग का दौरा किया। UPGMS के सदस्यों के साथ बैठक के अतिरिक्त टीम ने कुछ फैक्ट्रीयों का भी दौरा किया।

पूजा ग्लास वर्क्स प्राइवेट लिमिटेड : यह फैक्ट्री फिरोजाबाद के राजा का ताल क्षेत्र में लगभग 20 एकड़ भूमि में फेली हुई है। इस फैक्ट्री में प्रेस और ब्लो विधि द्वारा कांच के विभिन्न आकार और रंग के बर्तन, कटोरे इत्यादि का उत्पादन किया जाता है। AIGMF टीम ने फैक्ट्री की उत्पादन प्रक्रिया को देखा।

इसके उपरांत श्री देवीचरण अग्रवाल, प्रबंध निदेशक, पूजा ग्लास वर्क्स प्राइवेट लिमिटेड के साथ चर्चाये की गई। श्री अग्रवाल ने कांच और कांच के बने पदार्थो का व्यापार वर्ष 1970 में शुरू किया। पूजा ग्लास का उत्पादन वर्ष 1990 में आरंभ हुआ जो कि आज भारतीय कांच उद्योग के अग्रणी निर्माताओं में से एक है। श्री अग्रवाल ने बताया कि वह कांच की गुणवत्ता पर विशेष ध्यान देते हैं जिसके फलस्वरूप प्रतिवर्ष 15 करोड़ रुपए का उत्पादन स्वदेशों में निर्यात किया जाता है।

श्री अग्रवाल ने आगे बताया कि यह एक श्रम प्रधान उद्योग है और फिरोजाबाद (जो की भारत के कांच उद्योग का मुख्य केंद्र है) की जनसंख्या का एक बड़ा हिस्सा जुड़ा हुआ है।

पूजा ग्लास में एक कैंटीन है जो उचित दामों पर कर्मचारियों को भोजन आदि प्रदान कराती है।

उन्होंने बताया की गैस की आपूर्ति सबसे बड़ी समस्या है जिसके लिए उन्होंने गेल सीएनजी को अनुरोध किया। गेल ने एक प्रस्ताव के साथ प्रतिक्रिया व्यक्त की है कि उद्योग जगत छह महीने की अवधि के दौरान आवश्यकतानुसार अधिक से अधिक सीएनजी का उपयोग कर सकता है। जिसके उपरांत उनका गैस कोटा बढ़ाया जा सकता है। इस पर श्री अग्रवाल ने बताया कि कांच विनिर्माण इकाई की स्थापना 6 महीने की अवधि में संभव नहीं है। इस प्रकार कई उद्यमि इस प्रस्ताव का उपयोग अपनी क्षमता का विस्तार करने के लिए सक्षम नहीं होंगे। उन्होंने यह भी कहा कि प्राकृतिक गैस की दामों में वृद्धि के कारण उत्पादन की लागत बढ़ रही है जिससे उन्हें अंतरराष्ट्रीय बाजार में चीन और अन्य देशों के साथ प्रतिस्पर्धा करने में समस्या हो रही है।

गणेश बीड्स इंडस्ट्रीज : श्री. बी. के. गर्ग, पार्टनर, गणेश बीड्स इंडस्ट्रीज ने AIGMF टीम को फैक्ट्री से अवगत कराया। उन्होंने बताया कि इस इकाई में विभिन्न आकारों और रंगों की चूड़ियों का निर्माण किया जाता है। रंगीन चूड़ियाँ बैच में अपेक्षित या आवश्यक रंग का उपयोग करके निर्मित होती है। एक अन्य विधि से इन चूड़ियों पर आवश्यक रंग स्प्रे के द्वारा चढाया जाता है। उन्होने बताया कि यह एक अच्छी प्रबंधित इकाई है, जहॉ गर्मी के बाहर जाने के लिए पर्याप्त खुली जगह है इस प्रकार परिसर में अत्यधिक गर्मी भी नहीं होती और फैक्ट्री का तापमान बाहर के तापमान के सामान ही रहता है।

आकाशवाणी ग्लास वर्क्स – श्री परसा ने बताया कि उनके पूर्वजों ने फिरोजाबाद के गांव उरमरा और जसराना में कांच की चूड़ियों का उत्पादन प्रारम्भ किया। पहले चूड़ियाँ छोटे छाल की भट्टी और कड़ा छाल भट्टी नामक भट्टियां के माध्यम से निर्मित की जाती थी। इसके बाद टैंक भट्ठी और पाट भट्ठी के माध्यम से इनका उत्पादन होने लगा। रिजनरेटिव टैंक भट्टियां के माध्यम से चूड़ियों का निर्माण 1975 में आरम्भ किया गया। लस्टर पॉलिश का कार्य उनके पिता की फैक्ट्री मेसर्स शारदा ग्लास वर्क्स में वर्ष 1969 में आरम्भ हुआ।

चूड़ी निर्माण में आकाशवाणी ग्लास ने एक लंबा रास्ता तय किया है। आज उनके पास रिजनरेटिव टैंक वाली भट्टियां है।

AIGMF की UPGMS सदस्यों के साथ बैठक

28 अप्रैल, 2011

होटल अरोमा, फिरोजाबाद, उत्तरप्रदेश

सचिव AIGMF ने सदस्यों को बताया कि अध्यक्ष AIGMF ने कल्लेट के बारे में डेटा की आपूर्ति का एक महत्वपूर्ण कार्य AIGMF टीम को सौंपा है। सचिव AIGMF ने अनुरोध किया की वह बैच में कल्लेट के उपयोग का डाटा प्रदान करे जिससे सरकार को बताया जाएगा की कांच उद्योग अधिक कल्लेट के उपयोग से कच्चे माल और खनिज पदार्थ की बचत कर पा रहा है, जो कि पर्यावरण कि लिए उत्तम हैं।

टूटे हुए कांच (कल्लेट) के उपयोग से नवीन कांच के निर्माण में कच्चे माल की तुलना में ऊर्जा का कम उपयोग होता है। एक शोध के अनुसार, बैच में कल्लेट की 10% वृद्धि से कार्बन डाइऑक्साइड में 17% की कमी (CO_2) और बिजली और प्राकृतिक गैस में 2.5% की कमी होती है।

वर्तमान रीसाइक्लिंग का स्तर बैच संरचना का 25–30% है जो उद्योग जगत अपने प्रयास से स्वयम प्राप्त करता है। कल्लेट के कम उपयोग का मुख्य कारण इसकी कम उपलब्धता है, अवैधानिक रूप से खाद्य, दवा और मदिरा जैसे क्षेत्रों में पुरानी कांच की बोतलों का उपयोग किया जा रहा है। कार्बन डाइऑक्साइड और अन्य प्रदूषक गैसें जो की ईंधन के उपयोग से उत्पन्न होती है, बैच में अधिक कल्लेट के उपयोग द्वारा कम की जा सकती है। सचिव AIGMF ने कहा की इस डेटा को देकर हम सरकार को बताने का प्रयास करेंगे कि कांच उद्योग पर्यावरण के अनुकूल है, और कांच उद्योग को उत्पाद शुल्क आदि में और अधिक छूट दी जानी चाहिए।

बैठक में AIGMF सचिव ने UPGMS सदस्यों को त्रैमासिक पत्रिका कांच के हिन्दी पृष्ठों से अवगत कराया। उन्होंने सदस्यों से अनुरोध किया कि वह काँच में प्रकाशन के लिए विज्ञापन लेख / विस्तार / हिन्दी और अंग्रेजी भाषा में समाचार आदि में समर्थन दे। सदस्यों को यह भी बताया गया कि वे AIGMF वेबसाइट पर भी विज्ञापन दे सकते हैं। जिस पर प्रतिदिन लगभग 70–80 आगुन्तक LOG ON करते हैं।

UPGMS के कई सदस्यों ने 1% केंद्रीय उत्पाद शुल्क का विरोध किया जो की केंद्रीय बजट 2011–12 में माउथ ब्लोवन प्रक्रिया से बने कांच के उत्पादों पर लगाया गया है। सदस्यों ने बताया कि यह उत्पाद हस्तकला वर्ग के अंर्तगत आते है और इन वस्तुओं पर उत्पाद शुल्क लगाना उचित नहीं हैं।

सचिव AIGMF ने इस विशेष बैठक की व्यवस्था और चर्चायो के लिए UPGMS अध्यक्ष का धन्यवाद किया। बैठक का समापन अध्यक्ष को धन्यवाद के साथ हुआ।

Recycling one glass bottle saves enough energy to power a 60-watt bulb for four hours, a computer for 30 minutes or a television for 20 minutes

Indian Glass Directory 2011

AIGMF will soon publish revised edition of Indian Glass Directory.

It will include details of manufacturers of primary glass products and others connected with the Glass Industry, e.g. suppliers of raw materials, refractories, chemicals, machinery and equipment, consultant etc.

The Directory will also include details of secondary glass products such as products manufactured by processing of flat glass, i.e. toughened / automotive glass and other articles made from flat glass, decorative glass articles, ophthalmic glasses, fiber glass products etc.

You can also advertise your products in the Directory. The Advertisement Tariff is given below:

	Indian Companies (Rs.)	Foreign Companies (US $)
Front Cover	50,000	2,500
Back Cover	40,000	2,200
Inside Cover (Back)	25,000	1,400
Inside Cover (Front)	25,000	1,400
Extra Inside Cover (Back)	20,000	1,200
Extra Inside Cover (Front)	20,000	1,200
Full Page Coloured	15,000	1,000
Centrespread (2 pages opp. to each other)	50,000	2,500
Full Page Black & White	10,000	600
Half Page Black & White	8,000	400

The print area is 18x25 cm for full page advertisement and 20x21 cm for the glossy front-cover four colour advt.

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

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

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

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

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

Remittance from abroad to:

Bank of Baroda, New York, SWIFT BIC :

BARBUS33, FEDWIRE/ROUTING NUMBER:

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

Account No.	:	05860200000294
Name	:	The All India Glass Manufacturers' Federation
Bank	:	Bank of Baroda
Branch	:	Parliament Street, New Delhi
City	:	New Delhi, India

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

Remittance from India to: (deposit cash or make NEFT- online payment)

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

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

Glass Bangles of Firozabad
(A Preview)

Firozabad, known as Glass city of India, is in the state of Uttar Pradesh.

The bangle industry of Firozabad is about 300 years old. Glass industry in Firozabad is one of the country's biggest glass industry clusters in India.

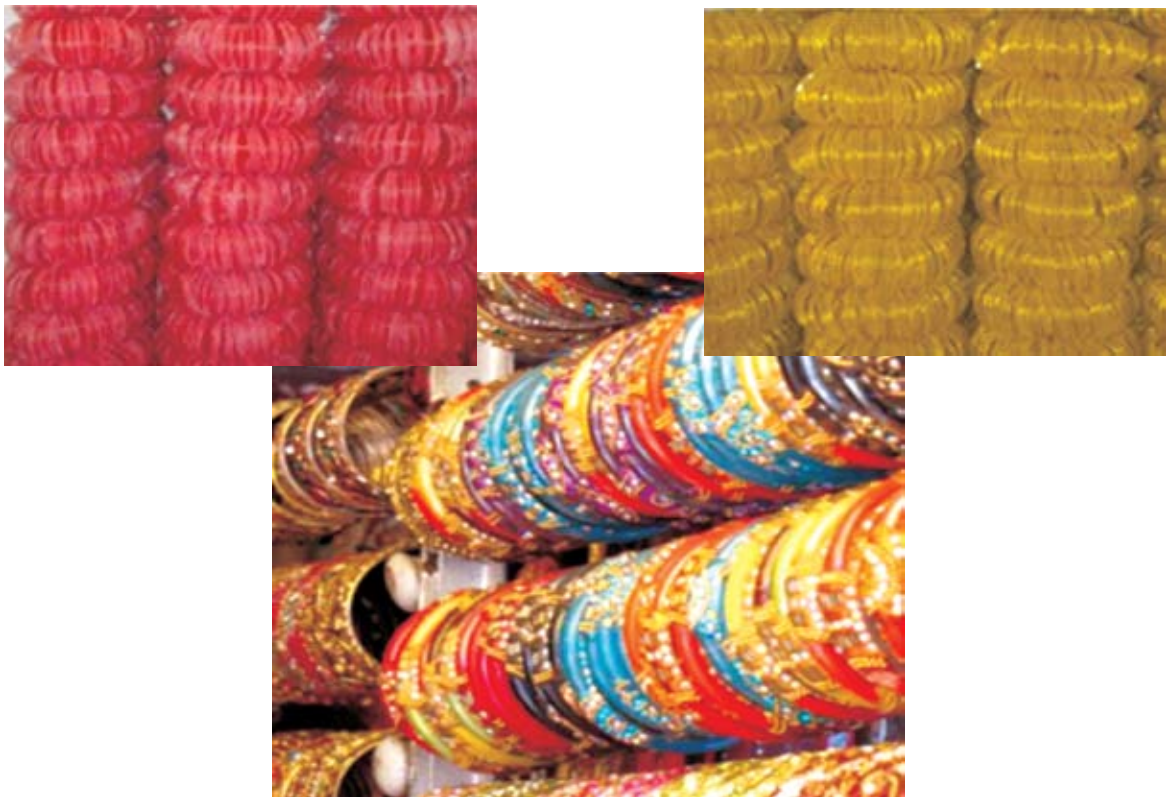
All sorts of glass articles, including bangles, kitchen wares, table wares, jars, candle stands, tumbler, flower vases, and decorative lights, bulbs and every other sort of glass articles are manufactured in this city. These articles are painted with vivid colours and innovative patterns. Etching is done on some products to enhance their beauty. Decoration work is also done on some products. With technical manpower available in the city they can manufacture almost anything which has a demand.

Glass bangles, the type that dominates the shops of the bangle market, have their prime source in Firozabad. The industry employs directly and indirectly about five lakh persons, manufacturing various items such as glass beads, lamps and multicoloured bangles. The bangle industry alone employs about one lakh workers including women, engaged in the Sadai (straightening out of the bangles) and Judai (welding the joints of the bangles).

The process of manufacturing these bangles is long and intricate, involving extremely precise and detailed work. The raw glass that is used is the same as the one used for all the other glass products made in the factories. The molten glass is passed through furnace pipes, and this glass is beaten into equal dimensions without removing the pipes. This molten glass, still within the pipes, is passed through automated rollers, which stretches it out like a thread. This thread, like molten glass wraps itself around the roller and a spring of glass is thus formed. This spring is cut with the same cutter as is used on diamonds.

The next step of the process is called Sadai, where the jagged joints of the bangles are smoothened out and made to look like one continuous ring. The glass is made to melt a little and by applying pressure on both ends, the joint is straightened out. This part of the process is usually carried out by women workers.

The last and final step of the process is called Judai. These open-ended springs of glass need to be joined



to form bangles. This part of the process happens in a separate unit. The process of joining bangles is termed 'judai'. Using a chimney of kerosene that is connected to an air compressor, known as 'pankha' by the workers, the two ends of the glass spring are joined.

It still has to pass through almost 10 to 15 hands, before it appears on the stalls. This is the part where the bangle is decorated, using ornamental pieces of mirrors, glitter and various other embellishments.

Making a kada has the same process, but here, several bangles are melted together to make a thick bangle that is called a kada. With a thin glass stick, designs are drawn on this kada and sometimes engravings are also done using rotating grinders. The process also changes slightly in the case of multi-coloured bangles. Sometimes, a hardener and resin are mixed in equal quantity, making a paste that is then coated on the bangle. After this, the bangles are collectively rolled over Zari powder.

Firozabad has earned the sobriquet of Suhag Nagri (the city that supplies bangles for married women). These colourful and shiny bangles are a symbol of marriage and prosperity of the women who wear them.

Glass Recycling is the process of turning waste glass into usable products, which help Conserving Natural Resources

FORMA GLAS GmbH

Handel mit Waren aller Art - Trading Company

Salzburgerstr. 1
A-5145 Neukirchen/E.
Austria
www.formaglass.com

The company FORMA GLAS GmbH Austria is a well known producer for machines for stemware lines, tumblers and pressed glass. Since the foundation of FORMA in 1968 and the first installation of a stemware line in 1970 more than 75 production lines have been sold and started up worldwide until now.

The new Generation of blowing machines has come - 2010 the first machine with FORMA segment construction method is used in operation.

The segment design offer many advantages to your traditional construction:

- an economic production
- with Siemens Simotion Control system
- single station drive - including front control panel
- servo raising station
- easy assembly and repair processes
- great time saving when changing the station - from the current 2 hours only 10 min
- our highlight - we are able to melt the glass in FORMA machine with a very high quality - no difference form traditional manufacturing methods

Product range:

- Blowing machines – Type IBS with 8 to 32 stations for production of stemware, tumbler,
- Presses - Type ISP with 8 to 20 stations for stems, optical glasses and small gift.
- Blowing Machines for big items up to dia 240 mm, hight 350 mm and 3 kg gob weight
- Type ISP 12/14 double-gob-press
- Press type RPH with 3 to 24 stations for tumbler, tea cups, bowls, vases and gift items
- Feeder units - mechanical and servo technology, ball gatherer type
- Platinum feeder
- Handling devices
- Conveyors
- Washing conveyors
- Fire polishing machines
- Melting machines
- Scissors
- Spinning machines
- Crack off machine with 12 to 40 stations for finishing stemware and tumblers.

The new agent for India:

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GOKHALE NAGAR,
PUNE- 411016. INDIA.
Contact Person : SUDEEP JINDAL.
Pune: +91 9049988754 / +91 (0)20 2566 1969.
Email- sudeepjindal2001@yahoo.co.in

Glass News- India

Glass-Makers Line Up Rs 7,000-Cr Investment over next 2-3 Years

Anticipating a surge in domestic demand, Indian glass manufacturers are ramping up their capacities and infusing new technologies, having lined up a total investment of over Rs. 7,000 crore for the next two to three years.

In the last three years, the industry has invested about half this amount for capacity-building owing to relatively slower demand growth.

The domestic glass industry, estimated to be about Rs. 18,000 crore, expects per capita consumption to nudge up from the current levels of 1.2 kg in the container glass segment and 0.8 kg in the float glass segment. The per capita consumption in other developing countries is about 8-9 kg in both the categories, while that in the US is estimated at 35 kg.

The Indian glass industry currently produces about 7,000 tonnes per day of container (or hollow) glass and 4,500 tonnes per day of float glass (used in buildings, automotive and other sectors), besides a range of speciality glass, including those used for solar panels.

HNGIL has lined up a Rs. 1,500-crore expansion for the next 12 to 18 months to add a capacity of 1,000 TPD through a new plant at Naidupetta and brown-field expansion of its Nasik facility. Besides, its subsidiary, HNG Float Glass Ltd, is investing another Rs. 850 crore to expand the capacity of its existing facility by 300 TPD in the next two years.

Similarly, AGI Glaspac is investing Rs. 600 crore to add 450 TPD capacities.

Float glass manufacturers are estimated to have lined up investment of over Rs. 3,000 crore. Leading in this category is Saint Gobain Glass India, which is pumping in Rs. 1,000 crore in various projects in the next two years. This includes Rs. 800 crore for its new facility coming up in Bhiwadi in Rajasthan, which is expected to be commissioned in the first quarter of 2012, and Rs. 100 crore each in its existing facility in Chennai and the recently acquired Sezal plant in Gujarat.

In an effort to bring down costs, the industry is planning to switch over to natural gas from furnace oil.

Solar Energy Biz Hits New Frontiers

The national solar mission is bringing in a whole new set of businesses associated with solar energy. The mission, under which investors bid to build solar power plants, is likely to attract an overall investment of about $70 billion according to government estimates. The plan seeks to boost green power generation from near zero to 20 gigawatts (GW) by 2022.

Ancillary industry is developing around low iron glasses, which is used in the production of photovoltaic solar panels, which in turn are used to generate energy from sunlight. According to government estimates, the demand for low iron glass is expected to surge by over 85% over in the next 5 years from the current 4 million square meters per year.

Till date, most solar project developers were importing the glass from China. However, the game changed with the entry of low iron producer Gujarat Borosil. “Thanks to huge demand from manufactures and other glass firms, we have gained tremendous marketshare,” said Phiroze J Masters, executive director (marketing), Gujarat Borosil.

Others seem to be following suit.

Hindusthan National Glass (HNG) has lined up plans to venture into manufacturing of glass for solar PV cells. “We expect the requirement of glass for the Indian solar industry to grow by 30-40% CAGR by 2020,” said Kailash C Jain, president, HNG Float.

Saint-Gobain Glass India Ltd is also keen to establish a solar glass complex with an investment of Rs. 500-600 crores. The plant is likely to come up in Tamil Nadu or Andhra Pradesh.

Tata Refractories Krosaki Stake Acquisition

Tata Refractories has been renamed TRL Krosaki Refractories after Japan’s Krosaki Harima Corporation acquired 51% equity stake in the company from Tata Steel recently.

The change in the name of the company, based at Belpahar in Jharsuguda district of Orissa for which necessary approvals have been obtained from the Registrar of Companies, Orissa.

Krosaki Harima Corp, which got inducted into TRL, is an associate of Japan’s Nippon Steel. The deal was valued at Rs. 576.3 crore, going by Tata Refractories’ valuation at Rs. 1,130 crore. This makes it one of the largest foreign acquisitions in the domestic refractories sector.

One of the largest refractory companies in the country, Tata Refractories caters to refractory consuming industries such as steel, glass, cement, non-ferrous and petrochemicals, both in India and abroad. It also has operations at Salem in Tamil Nadu, Jamshedpur, Samkhiyali (Gujarat), Jhansi and Hyderabad. It has an overseas manufacturing unit at China. In a notification to the Bombay Stock Exchange, Tata Steel said the company has completed the transaction and received the relevant consideration for the transfer of 51% equity shares of TRL out of its current stake of 77.46% stake.

Saint-Gobain Plans Rs.1,200-Cr Investment

Saint-Gobain Glass India Ltd (SGGI), a 100 per cent subsidiary of France-headquartered float glass manufacturer, Saint-Gobain, has decided to invest nearly Rs.1,200 crore in various projects over two years.

It is also planning to invest an additional Rs.100 crore in Sezal Glass, the newly acquired float glass business in Gujarat.

The company would invest Rs.100 crore in and around the existing Sriperumbudur facility located near Chennai to manufacture float glass for the architecture and automotive industry.

Sezal Glass Sells Unit to Saint-Gobain India

Sezal Glass, a glass-processing company, sold its float-glass business to Saint-Gobain Glass India for 6.86 billion rupees ($152.4 million).

The deal was a slump sale, a term that refers to a company selling its assets and liabilities for a single lump sum without assigning separate values to each.

Sezal Glass, in a notification to the National Stock Exchange, said the sale was approved by the company's shareholders.

The floating glass facility in Jhagadia Industrial Estate in the western state of Gujarat has the capacity to produce 550 tons per day.

HSIL to Invest Rs. 650 Cr on Capacity Expansion in 3 Years

Hindustan Sanitaryware & Industries Ltd (HSIL) has plans to invest Rs. 650 crore for capacity expansion in the next three years.

The company, which has two divisions - building material and container glass, plans to invest in both new as well as existing facilities.

"We plan to invest Rs. 650 crore in capacity expansion in the next three years. Our existing plants as well as the new plants will be covered under this capex," HSIL President RB Kabra told PTI.

The company will invest Rs. 200 crore on its sanitaryware and ceramics business, while Rs. 350 crore will be on its container glass business. Another Rs. 100 crore will be invested on the bathroom fittings business.

"We plan to invest Rs.75 crore in augmenting sanitaryware capacities in our plants in Bibinagar and Bahadurgarh and Rs.125 crore for the first phase of a new plant at Jhagadia in Gujarat," said Mr. Kabra.

The company had recently signed a memorandum of understanding with Gujarat government to set up the plant at Jhagadia.

The company aims to touch 5 million pieces a year mark by 2013-end from the current 2.8 million pieces annually after the capacity expansions.

It also plans to invest Rs. 90 crore to set up a new facility at Bhiwadi. The facility will focus on chrome plated faucets and is expected to be completed by December, 2012. The company has already acquired 10 acres land for the purpose.

"Another Rs. 10 crore would be go in augmenting the capacities of the existing plant there," said Mr. Kabra.

HSIL will also invest Rs. 300 crore on its Bhongir facility in Andhra Pradesh. HSIL also plans to spend another Rs. 50 crore on its Sanatnagar facility near Hyderabad. The two facilities will produce container glass.

"Our glass melting capacity will rise to 1,500 tonne by January, 2012 from the present 1,125 tonne a day, with these expansions," said Mr. Kabra.

The company posted a net profit of Rs. 87.35 crore for the year ended March 31, 2011. Its net sales for the year crossed Rs. 1,000 crore mark and stood at Rs. 1,035.33 crore.

HNG Announces Acquisition of Agenda Glas Ag, Germany

First international acquisition with an investment of ~ 50 million euro (Rs. 321Cr) over next one year will drive vision to becoming one of the top 15 glass packaging companies globally

Hindusthan National Glass (HNG), one of the frontrunners in the Indian packaging industry and India's leading glass container manufacturer with ~ 55% market share in the Indian glass packaging segment, acquired Agenda Glas, AG situated in Gardelegen, Germany, entailing an investment of ~ 50 million euro (Rs. 321 Cr)

over next one year. The acquisition will act as a stepping stone to the Company's global growth plans and will drive HNG's vision of becoming one of the top 15 global glass packaging companies. Agenda Glas went into bankruptcy proceedings in February 2011, and its assets are being acquired by HNG Global GmbH (a 100% subsidiary of HNG) through an international bidding process. The acquired company is a new facility catering to the alco-bev segment, with state-of-the art technology and has a production capacity of 320 tonnes per day (tpd). It had started its commercial production in February 2010. This acquisition shall be funded by a combination of the debt and equity.

Mr. Mukul Somany, Vice Chairman and Managing Director of Hindusthan National Glass and Industries Ltd. said "Through this acquisition, we plan to set our foot into the container glass manufacturing segment in the international market and we will also be following a high growth path in the next 3 years. In India, we have been looking at aggressive organic growth through greenfield and brownfield expansions with an investment of Rs. 2500 crores. The inorganic growth in building up manufacturing presence in the international market is also crucial to the Company's strategic global expansion plans and vision to becoming one of the top 15 global glass packaging companies."

Exports to over 23 countries in Europe, USA, UAE and Africa already contribute a portion of HNG's Rs. 1500 Crore annual turnover. HNG Global GmbH will enhance HNG's technical capabilities in terms of advanced technology and production processes, enabling the company to penetrate into European market, one of the largest markets with food and alco-bev industries as major demand drivers.

In the domestic market, HNG's total production capacity of 7.85 lakh tons in the last fiscal, is expected to go up to 12 lakh tons in the financial year 2011-12. Its major expansion and capacity enhancement plans include the greenfield Naidupeta plant complex with a capacity of 650 tpd, the brownfield expansion at Nashik plant with a capacity to produce 650 tpd. The flagship company of HNG Group, HNG is a pan-India company, with a multi-locational spread of plants and also the largest player in overall glass industry in India in capacity terms. HNG offers the widest range of bottles ranging from 5 ml to 3200 ml with downstream applications in the liquor, beer, beverages, pharmaceuticals processes, foods and cosmetics industries.

Now Even Glass Window Can Generate Solar Power

The engineering, procurement and construction (EPC) arm of Moser Baer Solar has installed a solar application that converts glass windows, front facades and exteriors into solar panels that capture sunlight and convert it into power.

Using this technology, called building integrated photovoltaic (BIPV), the Moser Baer arm has converted the exterior façade on the front of the Jubilee Hills shopping complex in Hyderabad into solar panels to erect a 1.8 kwp solar application.

These panels generate electricity to meet the power requirements in the corridors of the shopping complex. The commissioning of the building integrated photovoltaic application in India heralds the arrival of this new age technology which would allow commercial buildings to increase the use of renewable source energy in an aesthetic manner.

KN Subramaniam, chief executive of Moser Baer said, "The photovoltaic applications were no longer stand alone solar panels but could be a combination of sun and structures that led to opportunities to convert windows, exteriors and other integrated applications into solar panels in a commercially viable manner.

Glass News- Worldwide

AGC Develops World's Thinnest Sheet Float Glass at Just 0.1 MM

AGC has developed ultra-thin sheet glass manufactured using the float process, measuring just 0.1 mm, roughly the thinness of a sheet of paper. Made from alkali-free glass, which is used as a glass substrate for TFT-LCDs, AGC's unprecedentedly thin sheet float glass will be used in next-generation displays, lighting, touchscreens and high-tech applications such as medical devices. Recent shifts towards increasingly thin and energy saving displays and OLED lighting are now being taken to the next level with the development of next-generation flexible displays and OLED lighting. This is creating more demand for glass materials, including

glass substrates and cover glass for touchscreen panels and glass substrates for displays. Thin sheet glass is expected to be used in such products due to its flexible shaping and light weight, as well as basic characteristics of glass such as transparency, electrical insulation and resistance to heat, chemicals and gasses.

AGC has extensive experience with the production of thin sheet glass. Over five years ago, the company began mass producing and shipping 0.4 mm, alkali-free glass as a TFT glass substrate. Later, the thickness was reduced to 0.3 mm. In April of this year, AGC began selling the world's thinnest, 0.28 mm, soda-lime glass substrate for touchscreens.

AGC is contributing to more environmentally friendly and comfortable lifestyles by developing new technologies and expanded applications for glass under its Grow Beyond strategy of building new foundations for growth through innovative solutions

O-I Working To Bring Back The Glass Milk Bottle

The Australian arm of the glass making giant, O-I, has released results of new consumer research that shows Australian consumers would seriously consider buying their milk in glass bottles if it was back on the shelves.

The research commissioned by O-I and conducted by Ipsos Australia, showed 50% of all white milk buyers and 51% of flavoured milk buyers found the concept of milk packaged in glass bottles appealing.

The study also revealed 42% of white milk buyers and 28% of flavoured milk buyers believed milk would taste better in glass versus other packaging types.

O-I conducted the research to examine the habits of Australian milk buyers and the attitudes of consumers towards milk packaged in glass bottles. Availability of milk in glass is currently limited but O-I believes it is on the verge of a comeback.

Other key research findings included:

- 58% of white milk buyers cited the 100%, recyclability of glass as a benefit of milk packaged in glass.
- 46% of flavoured milk buyers identified the ability of glass to keep milk colder for longer as a benefit of milk packaged in glass.
- 63% of 30-34 year-olds found white milk packaged in glass appealing.
- 68% of 25-39 year-olds found flavoured milk packaged in glass appealing.
- 49% of white milk buyers were considered medium users and purchased three to seven litres of white milk per week.
- 42% of flavoured milk buyers were considered medium users and purchased two to four bottles or cartons of flavoured milk per week.

Brian Slingsby, General Manager O-I Australia, said the research identified increasing consumer desire for more milk to be packaged in glass.

"Australians love a comeback and we expect to see the application of glass packaging across a number of milk brands in the near future," said Mr. Slingsby.

"The research indicates milk packaged in glass is associated with a wholesome, quality image due to the ability of glass to keep beverages colder for longer and not interfere with taste."

In response to the consumer research which highlighted milk as a regular, habitual purchase, O-I has launched a new 750 ml glass bottle for the milk industry. The bottle has been designed to fit standard Australian and New Zealand milk crates ensuring convenient storage and transport.

"Glass packaging presents a significant opportunity for brands to differentiate their products by using a material that is 100% infinitely recyclable in a closed loop, from milk bottle to milk bottle," said Mr. Slingsby.

Single-Stage Forming Research Project

Heye International is proud to be an integral part of the new, government-sponsored EinFormGlas research project, exploring the viability of single-stage forming. Dr. Michael Kellner, Heye's Director of Research & Development and a key advisor on the project, suggests that the goal should be a modular system, capable of integration into existing production lines, as the development of a stand-alone machine could take 5-10 years.

One of the biggest challenges to glass as a packaging material is weight reduction. Traditional container glass manufacture employs a two-stage forming process, which uses a generous amount of glass and has the advantage that heat-retention allows minor surface imperfections to heal during production.

This self-healing does not occur in single-stage forming, leading to a lower overall consistency of production quality. Therefore, a primary goal of this project is to optimise the integrity and stability of the final product by, for example, eliminating sand accumulation or dust build-up in the furnace. This allows the creation of totally homogeneous batches. A further challenge is to avoid the occurrence of asymmetries in the gob, which requires an even temperature distribution within the glass. New advances in other areas, such as mould lubrication, are also important.

This first stage of the EinFormGlas project aims to reduce wall thicknesses by a third to only 0.7-0.8 mm. It further consolidates the position of German glass machine manufacturers as global leaders and advances the merits of glass as the most healthy and environmentally friendly packaging solution in the world.

Environmentally Friendly and New Generation Glasses for Plasma TV

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Abstract: *Glass plays an important role in the manufacturing of plasma display panel (PDP), that is, plasma TV. Glass is not only used there as front and back panel substrates, but also in its several components, such as front panel transparent dielectric (TD) layer, back panel opaque or white dielectric (WB) layer, barrier rib (BR) and sealing material in between front and back panels. In all the later cases, presently PbO is used in the tune of 60-80 wt% as a glass constituent. It is, therefore, essential to replace the PbO from glass compositions due to health and environmental issues keeping their existing properties unaltered. In this paper, an overview on the available PDP glasses and some of their key properties are reported. In addition, recent development carried at this institute on environmentally friendly lead-free dielectric glasses for plasma TV is briefly described. A low softening and dielectric constant lead-free ZnO-P_2O_5 based glass composition was also developed for manufacturing plasma TV in consideration of cost-effectiveness. We believe that this work will open up a new horizon in the plasma TV research and reduce its manufacturing cost significantly as well.*

Keywords: *Plasma display panel (PDP), Plasma TV, Glass, Lead-free glass, Low softening point lead-free glass, Low dielectric constant glass*

1. Introduction

In recent past, the commercial uses of flat panel displays (FPDs) have increased enormously, especially in case of consumer electronics such as televisions, laptop computers, digital clocks, cell phones, telephones etc. In such cases, the most widely used flat panel displays are the liquid crystal display (LCD) and organic light emitting diodes (OLED's). OLED's are mostly used for small displays in MP3 players and mobile phones and LCD is competing with plasma display (PDP) for sub 42 inch TV's and is being the display of choice for computer screens. But PDP is one kind of flat panel display which has emerged to be a potential display material for large dimension (> 100 inches) high definition TV. Significant quality differences remain between PDP and other flat panel displays (LCD, OLED etc.) while they offer some shared benefits. It is true that with the advent of more affordable LCDs and the competition from the latest LED TVs, the plasma television market has shrunk recently. This is mostly as the sales representatives continue to favor LCD and now the latest LED TVs over plasma with their hype regarding burn-in and excessive power consumption. PDP has always remained the TV technology of choice for videophiles, home theater enthusiasts, sports fans and consumers desiring a larger screen size. PDPs are characterized by larger screen sizes (greater than 100 inches), wide viewing angle, more accurate image reproduction with better colour accuracy, contrast and brightness, superior ability to display moving images without motion artifacts and better pixel reliability over LCDs or LEDs. The share of 3D PDP TV is expected to represent over 86% of all PDP TVs in 2013. Depending on the type of voltage that is used to generate the plasma, AC and DC PDPs can be distinguished. Almost all the PDP companies have now adopted the AC PDP.

In plasma display panels, its front and back panels are made up of glass. Besides, some of its components are also composed of glass frits and ceramic fillers (e.g., TiO_2, SiO_2, ZrO_2, Al_2O_3, MgO and cordierite) reinforced glass microcomposites, viz., white back dielectric layer, barrier rib etc. Presently various glass powders such as PbO-ZnO-B_2O_3 and PbO-ZnO-SiO_2 [1-3] are being used which contain large amount (60-80 wt%) of lead oxide (PbO). Lead oxide is used in glasses due to its low melting temperature and property tailoring ability. However, it creates hazardous effect on health and environment. The compositions and some key properties of PD200 glass substrate and different PDP glasses are presented in Table 1 and Table 2. As per the July 1, 2006

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legislation European Commission (EC), all applicable products in the European Union countries must comply with Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS). The scope of the WEEE and RoHS legislations cover various households' appliances, information technology and telecommunication equipment, consumer equipment, lighting equipment, electrical and electronic tools, toys and leisure equipment, and automatic dispensers. Since the RoHS legislation came into effect, technological changes have continued and our understanding of the reliability questions associated with lead-free glasses has improved. However, these technologies have yet to reach a stage of reliability and technical viability.

In this paper, a brief overview of different types of glasses used in plasma TV is presented. In addition, environmentally friendly lead-free plasma TV component glasses recently developed by the authors are also discussed.

2. Brief History about PDP

The very first prototype for a plasma display monitor was invented in 1964 by Donald Bitzer, Gene Slottow, and Robert Willson. These three researchers at the University of Illinois concentrated their efforts on constructing the next generation of computer display screens. Donald Bitzer, H. Gene Slottow, and graduate student Robert Willson invented the original monochrome panels for Bitzer's PLATO Computer system, one of the first computer-assisted instruction systems in the world. The original neon orange monochrome Digivue display panels built by glass producer Owens-Illinois were very popular in the early 1970s because they were rugged and needed neither memory nor circuitry to refresh the images. A long period of sales decline occurred in the late 1970s because semiconductor memory made CRT displays cheaper than the US$2500 512 x 512 PLATO plasma displays. Nonetheless, the plasma displays' relatively large screen size and one inch thickness made them suitable for high-profile placement in lobbies and stock exchanges. The present major manufacturers of plasma display are Panasonic Corporation, Samsung Electronics, LG Electronics, etc.

3. Brief about PDP Structure

A sectional view of plasma display panel (PDP) structure is represented in Fig. 1. The PDP uses two panels of glass that have been coated with the two different dielectric layers such as transparent dielectric, TD (in front panel glass) and rear dielectric (also known as white back, WB) layer that sandwich a thin layer of gas in several millions of tiny cells (fine discharge spaces). The plasma in each cell of an alternative current (AC) PDP is generated by dielectric barrier discharges (DBDs) operating in a glow regime in a rare gas mixture (typically 500 Torr, 100 μm gap). Each tiny cell is known as 'pixel' and each pixel is divided into three sub-cells. Phosphors in the three colours (red, green and blue (RGB)) are deposited on three sub-cells respectively. Varying the voltage of the signals to the cells thus allows

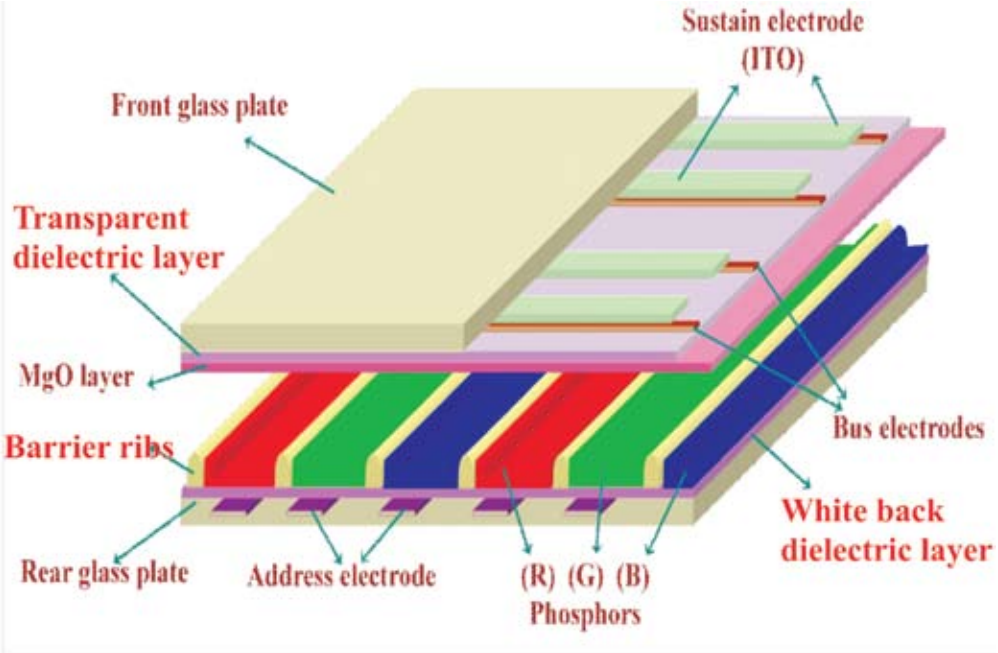

Fig. 1: Sectional view of a PDP discharge cells illustrating its structure

different perceived colors. Especially in plasma display panels (PDPs) various types of glass powders are used for sealing purpose, barrier ribs, dielectric layers of front and back panels. Therefore, glass plays an important role in the manufacturing of plasma TV. Glass is not only used as front and back panel substrate of plasma TV, it is also used in PDP as front and back panel dielectric layer or as barrier rib in between front and back panel or as sealing material. The functions of the dielectric layer are to limit the discharge current and to stabilize the plasma in the discharge cell. This dielectric layer should have high dielectric strength and good transparency. These two glass substrates are separated by a material called 'barrier rib', i. e., the partition. In PDP a rear glass dielectric layer (popularly known as white back) is used as the insulating film of the address electrodes on the rear glass substrate and also gives mechanical support to the barrier ribs (the partitions between the phosphor cavities). The dielectric layers (~30 μm thick) and barrier ribs (~120 μm height and ~80 μm thick) are formed by 'screen printing' on glass substrates in order to get the pattern. The dielectrics and barrier rib materials of PDP systems require a low dielectric constant (less than 15), low softening temperature (less than the strain point of PDP glass substrate which is 610°C for PD200) and low coefficient of thermal expansion (less than 83 x 10^{-7}/K) with respect to use of PD200 glass as substrate [4, 5].

4. Glasses and Its Microcomposites Used in Plasma Display Panels (PDPs)

Commonly three major components in PDPs other that two substrate plate glasses are made up of glass powders and its microcomposites. They are transparent dielectric, TD (front glass dielectric layer), white back, WB (rear glass dielectric layer) and barrier rib, BR (partition between phosphor cavities). It is technologically challenging to develop process technology as well as the befitting glass compositions to meet all the desired properties for PDPs application.

4.1. Glass Substrate for Plasma Display Panel

In PDPs, the two substrate glasses are used to coat the transparent dielectric (in front panel glass) and rear dielectric (in back panel glass) layers that sandwich a thin layer of gas in several millions of tiny cells (fine discharge spaces). The (Li_2O+Na_2O+K_2O)-(CaO+MgO+SrO+BaO)-Al_2O_3-SiO_2 based glasses have been widely used for the substrate glass in PDP owing to its high strain point which is in excess of 600°C. There are several patents [6-15] in this regard which disclose the compositions and some key properties like strain point, glass transition temperature, coefficient of thermal expansion etc. A typical high strain point PDP substrate glass composition (PD200) developed by Asahi Glass Company Limited, Tokyo is presented in Table 1. The relevant properties are shown in Table 2. Therefore, it is important to develop the low softening point glass powders and its microcomposites without PbO so that the deformation of substrate glass could be avoided.

4.2. Transparent Dielectric (TD)

In PDPs, the transparent dielectric material is important since it maintains the discharge, and protects the electrodes of the device. Moreover, its transmission characteristics affect the image quality of the display. Such a dielectric layer is formed by screen printing repeatedly about three or four times. For the development of a

Table 1: Chemical Compositions (wt%) of PDP Glass Substrate and Existing Different Lead-Containing PDP Component Glasses

Component	High Strain Point PDP Glass Substrate	Barrier Rib (Opaque)	White Back	Transparent Dielectric
SiO_2	60	37.2	21.6	8.0
Al_2O_3	5	0.7		0.6
B_2O_3		6.8	6.8	16.2
ZnO				7.5
PbO		62.1	71.6	67.7
SrO	7			
CaO	8			
MgO	2			
ZrO_2	7			
Na_2O	4			
K_2O	7			
Total	100	100	100	100

Table 2: Some Key Properties of PDP Glass Substrate and Existing Different Lead-Containing PDP Component Glasses

Properties	High Strain Point PDP Glass Substrate	Barrier Rib (Opaque)	White Back	Transparent Dielectric
Strain Point (°C)	582	-	-	-
Annealing Point (°C)	626	450	461	495
Softening Point (°C)	836	484	492	580
CTE (x 10^{-7} K^{-1})	83	73	78-80	75
Dielectric Constant (1MHz)	10.3	9.5	14	9.5

reasonable dielectric layer for a PDP, several properties are required, such as: high transparency (above 80% after firing), low firing temperature of about 550-580°C, dielectric constant below 15, and a reasonable thermal expansion coefficient (8-9x10^{-6} K^{-1}) to match the glass substrate. Low melting and firing temperatures required for price competitiveness and may affect market share for PDPs since it is in competition with LCD technology. Therefore, it is important to obtain a low dielectric constant and firing temperature without impeding other requirements such as thermal, optical, and morphological properties. The PbO-B_2O_3-SiO_2-ZnO glasses have been widely used for the transparent dielectric layer in PDP owing to its low firing temperature below 580°C. However, the use of Pb should be terminated because of its toxicity to the human body and environment.

4.2. Rear Dielectric or White Back (WB)

In PDP white back dielectric (rear glass dielectric) is used as the insulating film of the address electrodes on the rear glass substrate and gives support to barrier rib. Glass powders are widely used as white back materials with addition of various types of ceramic oxide (e.g. SiO_2, TiO_2, etc) as filler for adjustment of its desired properties as well as improvement of its mechanical strength. Lead (Pb) based frits of PbO-B_2O_3-ZnO and PbO-B_2O_3-SiO_2 glasses are very popular as the commercial materials for PDP. For white back, reflection is another most important property other than other properties. Therefore, lead is used in this type of glass due to its low softening point (T_s) as well as high refractive index. Here, lead oxide (PbO) is used to the extent of 60-80 wt%.

4.3. Barrier Rib (BR)

Recently, glasses reinforced by ceramic fillers, such as Al_2O_3, SiO_2, TiO_2 etc. have been used as the barrier ribs of plasma display panels (PDP). The barrier rib, in essence, is a glass matrix composite reinforced with ceramic fillers. The compositions (wt%) of the glass matrices used are generally in a range of (60-75)PbO-(2-25)SiO_2-(2-20)B_2O_3 with minor components, such as Al_2O_3, ZnO, TiO_2, and MgO. The ceramic fillers are added to the glass matrix primarily to prevent slumping of the ribs during sintering. The addition of filler generally improves the dimensional stability of the ribs during sintering but also influences the physical properties of the ribs, such as the dielectric constant, thermal expansion coefficient, and viscosity. As these properties affect the performance of PDP, it is crucial to select a proper combination of glass matrix and filler material for the ribs. As a filler material, Al_2O_3 powder is most commonly used because of its phase stability and chemical inertness. Al_2O_3 powder, however, has a moderately high relative dielectric constant (8.8-10.1) and thermal expansion coefficient (8.0x10^{-6} K^{-1}). For a fast signal response characteristic of the PDP, the dielectric constant of the ribs needs to be 10. The dielectric constants of currently used lead borosilicate glasses fall in a range of 10 to 15. Therefore, a filler material with a lower dielectric constant is required to further reduce the dielectric constant of the ribs. It is well-recognized that the addition of inert fillers reduces the rate of sintering and increases the possibility of generating flaws in the sintered body. The sintering temperature of glass filled with inert ceramic powders is significantly higher that of the glass matrix, which limits the use of the easily available and low-priced soda–lime glass substrates. The sintering temperature of glasses containing Al_2O_3 powder as the filler is in the range of 560° to 590°C, and the softening temperature of the soda–lime glass is 570°C. This demands the use of a glass substrate with a higher softening point, potentially increasing the cost of the PDP. Among the other oxide ceramics, fused quartz has a combination of desirable physical properties for a filler material. It has a dielectric constant of 4 and a thermal expansion coefficient of 11x 10^{-6} K^{-1}. The use of fused quartz as a filler should be more effective in reducing the dielectric constant of the barrier ribs. In addition, a reasonable difference in the thermal expansion coefficients between the filler and the matrix should make modification of the thermal expansion coefficient of the rib material more manageable.

There are several kinds of conventional manufacturing process for barrier ribs having each of shortcomings. Sandblasting method laminating selective protecting layer over glass paste takes severe material consumption rates. Screen printing method of laminating each glass paste layer is easy and common technique.

4.4. Sealing Glass

Sealing glass compositions is used for bonding the front and back plate substrate of PDP. For this purpose, high lead containing glasses are widely used for which the sintering temperature is leas than 400°C. The sealing glass prevents the deformation and cracking of a substrate caused by thermal and mechanical stress and reduces the sintering temperature to thereby enhance the air-tightness of the sealing glass.

5 Lead as an Environmental and Health Issue

Lead is one of the oldest industrial poisons. Contamination by industrial lead has occurred everywhere on the earth. Recently, the release of environmental contaminant PbO have increased enormously due to large production and uses of electrical and electronics gadgets which contain a large volume of lead components. A wide variety of adverse health effects arise from exposure to lead. It primarily affects the peripheral and central nervous systems, the blood cells and metabolism of vitamin D and calcium. There are many chronic effects like anaemia arising from inhibition of haem synthesis, chronic encephalopathy, cognitive impairment, sleeplessness, headaches, aggressive behaviours, convulsions, disruption of motor system and renal effects etc. arising from lead exposure.

6. CGCRI Contribution towards Lead Reduction from PDPs

Central Glass and Ceramic Research Institute, Kolkata recently developed the process and fabrication technology of some lead-free environmentally friendly glass frits for barrier ribs, transparent dielectric and white back of PDPs in collaboration with the M/s Samtel Color Limited, Ghaziabad under CSIR/NMITLI project.

6.1 Replacement of PbO from TD

Lead-free transparent dielectric (TD) layer attracted much attention of various researchers. In this context, Bi_2O_3, B_2O_3, BaO and ZnO are potential glass constituents to satisfy various requirements for TD. Recently, BaO-B_2O_3-ZnO, Bi_2O_3-B_2O_3-BaO-ZnO [16, 17] glasses were studied as a PbO free, low firing transparent dielectric layer for plasma display panels (PDP). The transparency of the Bi_2O_3-B_2O_3-BaO-ZnO glass system could be improved to a great extent by adding desirable amount of CuO and/or CeO_2 in these glass systems to eliminate yellowish or brownish color during PDP manufacturing. Table 3 shows the compositions of CGCRI developed lead-free TD glasses and Fig. 2 shows the TD coated PDP substrate (heat-treated).

Table 3: Composition and Properties of CGCRI Developed Lead-Free PDP Component (TD, WB, BR and BR) Glasses

Component and property	Chemical composition (wt%)	
	TD Glass	WB & BR Base Glass
SiO_2	0-6	6-9.5
B_2O_3	17-33	17-29
ZnO	2-46	42-51
Bi_2O_3	0-72	0-22
Al_2O_3	0-2	1
K_2O	0	0-0.5
Li_2O	0	0.5-2.5
CaO	0-5	0-5
MgO	0	0-4
BaO	0-45	0-14
T_s (°C)	505-546	547-551
CTE (x $10^{-7}/K^{-1}$)	73-101	71-84
Transmission (%T) at 550 nm, t = 2 mm	76-84	-
Dielcetric Constant (1MHz)	8.9-11.2	8.6-13.2

Fig. 2: CGCRI developed lead-free TD coated PDP substrate (heat-treated)

6.2 Replacement of PbO from WB & BR

Recently, some Pb-free glasses in the systems BaO-ZnO-B_2O_3, Bi_2O_3-B_2O_3-BaO-ZnO, BaO-B_2O_3-SiO_2 [18-21] etc. have been reported as alternate white back and barrier rib materials for PDP. The effects of various types of crystalline fillers (e.g. SiO_2, TiO_2, Al_2O_3, ZrO_2, MgO, etc) in some of these lead-free glasses are reported. But only a very few glass compositions have been reported for white back and barrier rib application. Bismuth oxide based glass could be selected as a substitute of lead

Fig. 3: CGCRI developed lead-free WB coated PDP substrate (heat-treated)

Fig. 4: CGCRI developed lead-free BR coated PDP substrate (heat-treated)

oxide based glasses as it is next to lead in the periodic table which has low melting temperature (820°C) and high refractive index (n = 2.5) as lead oxide (melting temperature = 880°C, n = 2.24). In this respect, CGCRI has developed the lead-free environment friendly low melting BaO-ZnO-B_2O_3 and Bi_2O_3-ZnO-B_2O_3 based glass systems which can be used for the development of opaque dielectric and barrier ribs glass microcomposites when added with some crystalline filler such as TiO_2, Al_2O_3 and SiO_2 etc. Table 3 shows the compositions of CGCRI developed lead-free WB and BR glasses and Fig. 3 and Fig. 4 show the WB and BR coated PDP substrate (heat-treated) respectively.

7. PDP-What Is Next?

Recently, it has been observed that there is growing interest to develop low softening point low dielectric constant transparent glass composition that can be used on the commercially available soda-lime silica glass substrate. Moreover, lower temperature processing helps achieve lower energy consumption leading to lower cost of production making the PDP more competitive in comparison to other flat panel displays like LCD. To develop the low softening point (<500°C) and dielectric constant dielectric glass layer and barrier rib on commercially available soda-lime silica PDP glass substrate, low melting ZnO-P_2O_5 based glass, SnO-P_2O_5 based glass, SnO-ZnO-P_2O_5, SnO-B_2O_3-P_2O_5, MnO-SnO-P_2O_5 and ZnO-Sb_2O_3-P_2O_5 [22-24] based glass systems are probable. In this respect, CGCRI has developed of lead-free environmentally friendly low softening point (<500°C) and dielectric constant ZnO-P_2O_5 based glass system with some other minor oxides which can be used as dielectric layer and barrier rib for the front and back panels of PDP made of an ordinary soda lime silicate (SLS) sheet glass. Compositions and properties of CGCRI developed low softening (500°C) and dielectric constant glasses for low cost PDP is presented in Table 4.

Table 4: Compositions and Properties of CGCRI Developed Low Softening (<500°C) and Dielectric Constant Lead-Free PDP Component Glasses for Low Cost PDP

Component and property	Chemical composition (mol%)
ZnO	40-45
P_2O_5	42-48
B_2O_3	0-5
SiO_2	0-6
Al_2O_3	0-5
Li_2O	0-5
Na_2O	0-5
K_2O	0-5
CaO	0-3
BaO	0-8
SrO	0-3
T_s (°C)	436-497
T_g (°C)	347-403
CTE (x $10^{-7}/K^{-1}$)	82-103
Dielcetric Constant (1 MHz)	6.4-9.3
Transmission (%T) at 550 nm, t = 2 mm	80-90
Nature of glass coating applied on silver electrode coated panel substrate heat-treated at 470°C/30 min. (±20°C)	Yellow-free translucent

8. Conclusions

In this paper, different types of glasses involved in manufacturing of plasma TV are briefly discussed. In addition, recent development carried at this institute on environmentally friendly lead-free dielectric glasses for plasma TV is also presented. A low softening and dielectric constant lead-free ZnO-P_2O_5 based glass composition was also developed for manufacturing PDP TV in consideration of cost-effectiveness. We believe that this work will open up a new horizon in the plasma TV research and reduce its manufacturing cost significantly as well.

Acknowledgements

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Use of Sodium Sulphate in Glass Batch Part III- Redox and formation of Amber Glass

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Abstract: *In this part of the review a brief account has been given of the concept of redox and what determines the redox state of a glass. The method of ascertaining the redox state of a glass melt has been discussed. Sulphur solubility changes with the oxidation potential of the melt showing a minimum at an oxygen partial pressure between 10^{-6} to 10^{-4} atm. While S^{6+} is the species at high oxygen partial pressure sulphide is the species at reduced pressure. In between, S is present as S^{+5}. The observations have been generalized in a curve of variation of sulphur solubility with batch redox number and dividing the various regions where clear flint reduced flint, green, light amber and dark amber glass may be produced. S in conjunction with iron in the 3+ state can produce different shades of amber.*

Introduction: In the first two parts of the review the effect of salt cake on the glass batch reaction and refining of glass were discussed. In this part the oxidation nature, sulphur solubility, redox and the formation of amber colour are presented.

Redox: This term is an abbreviation for the oxidation- reduction state of the glass and is mostly used to describe the oxidation potential of the glass melt. Considering the basic concept of oxidation as loss of electron and reduction as gain of electron the oxidation reduction may be written in a general form as:

$$M^{(x+m)+} + me \leftrightarrow M^{x+} \quad (1)$$

Where, M represents an element and x and m are the number of positive charge and me is the number of electron that has to be transferred if the oxidation reduction reaction has to take place..

Oxygen in glass melt may release or may take electrons

$$2O^{2-} \leftrightarrow O_2\ (g) + 4e \quad (2)$$

Combining equations 1 and 2

$$M^{(x+m)} + m/2\ O^{2-} = M^{x} + + m/4\ O_2\ (g) \quad (3)$$

The equilibrium constant may be written as

$$K = \frac{a\ Mx+\ .\ f_{O2}^{\ m/4}}{a\ M^{(x+m)}.\ a\ O_2^{-\ m/2}} \quad (4)$$

where a represents the activity and f the fugacity of the gas, and K the equilibrium constant

The oxygen ion activity for a glass of a given composition is constant. The metal ion concentration is low and the activity may be taken as equal to its concentration, c

Similarly, assuming that oxygen behaves as a perfect gas the fugacity may be taken as equal to the partial pressure, p. Equation 4 may be rewritten as:

$$K = \frac{c\ M^{x+}\ .\ p_{O2}^{\ m/4}}{c\ M^{(x+m)}.} \quad (5)$$

$$\text{or} \quad \frac{c\ M^{(x+m)}.}{c\ M^{x+}} = K'\ p_{O2}^{\ m/4} \quad (6)$$

where, K' is another equilibrium constant

Therefore, the ratio of the oxidized to the reduced species will depend on the oxygen partial pressure. This is for a given glass composition and for a given temperature. Experimentally a plot of the concentration of the oxidized to reduced species versus the logarithm of oxygen partial pressure measured under equilibrium condition has yielded a slope of m/4.

The equilibrium constant for a reaction changes with the temperature exponentially as

$$K = Exp.\ (-\Delta G_0/RT) = Exp\ -(\Delta H_0 - T\ \Delta S_0)/RT)$$

Where, ΔG_0 and ΔS_0 are the standard free energy and entropy changes for the reaction, R is the gas constant and T is the absolute temperature

Free oxygen ion activity and non-bridging oxygen ion activity: In the glass melt the oxygen potential may be a contribution of both the free oxygen ion activity and the basicity of the melt which depends on the amount of single bonded oxygen in the network and the nature of the modifier cation. If the glass melt is considered as a solvent for different polyvalent elements then the glass melt may be characterized as an acid –base medium according to the classical concept. To understand this we may look at the simplified glass network structure

and how the structure breaks down with the addition of modifier cation.

The classical glass structure as given by Zachariasen is shown below (Fig. 1). In crystalline silica the building unit is SiO_4^{4-} tetrahedral with one oxygen placed at each apex of the tetrahedron and shared with another tetrahedron. This continues and a network of SiO_4^{4-} tetrahedra are formed in three dimensions. In crystalline silica this has a well arranged structure. As the temperature is raised defects form in the crystalline structure and the ordered structure is destroyed and is able to flow when the defect formed is such that the network breaks into units capable of flowing. On cooling the liquid , because of its high viscosity, it does not have time to reorganize and forms a glass with random network as shown fin Fig. 1 (middle). In SiO_2 the Si:O ratio is 1:2. As oxygen is added to the melt via modifier cation like Na_2O the Si:O ration increases and some -Si-O-Si- bonds must break. This breaking of bond should continue as more and more oxygen is added (Fig. 1, right). It is possible that discrete groups of partially bonded –Si-O-Si- tetrahedra prevails

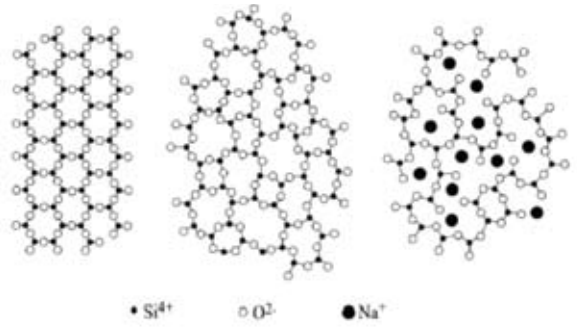


Fig. 1. structure of crystalline silica (left), vitreous silica (middle) and glass (right).

in the melt when sufficient modifier oxide is added. The properties of the melt like viscosity, thermal expansion etc. change.

The melt may be considered as a solvent and it may be considered as an ionized melt having positive and negative character like the acid-base concept. As shown below:

$$2SiO_2 \leftrightarrow SiO_{3/2}^{+} + {}^{-}OSiO_2$$

Or 2O- Si- O-Si-O $\leftrightarrow$ $3O{\equiv}Si^{+}$ + ${}^{-}OSiO_2$

The $O{\equiv}Si^{+}$ unit is proton rich and may be considered as an acid and the - $OSiO_2$ may be considered as the base as per classical concept of acid and base. The alkali oxide which is easily ionized may be incorporated as

$$3SiO_2 + M_2O \leftrightarrow O{\equiv}Si^{+} O^{-} + 2\,M^{+}\,{}^{-}OSiO_2$$

where' M is an alkali cation.

As the alkali concentration in the silica network increases resulting in breaking of Si-O-Si- bond the acid and base character of the melt increases. The degree of ionization also depends on the field strength (proportional to z/r^2 where z is the electric charge and r the radius of the cation) of the basic oxide and hence the basicity character also increases with the field strength as follows for example with alkali cations

Li > Na > K > Rb > Cs

Similar effect will occur with the addition of the alkali earth cations. This basicity therefore, increases with the increase of single bonded oxygen.

Free Oxygen ion activity : Gases like O_2, CO_2, SO_2 H_2O, nitrogen and inert gases dissolve in silicate melt. That dissolved gases exist in silicate melt may be observed by degassing it. The dissolution of gases may be of two types namely chemical dissolution and physical dissolution. In chemical dissolution the gas reacts with the glass chemically and becomes a part of the structure like water vapour dissolves in glass and the OH- replaces an O and breaks the Si-O-Si bond. The low viscosity of magma is due to the breaking of bond by OH- ion. When multivalent cations are present in the glass it undergoes oxidation reduction reaction and is fixed in the matrix by the reaction.

$$M^{m+} + n/4\,O_2(g) \leftrightarrow M^{(m+n)+} + n/2\,O^{2-}$$

Similarly SO_3, SO_2 and S may dissolve in the glass as sulphate, sulphite and sulphide. The same is true for CO_2. The amount of chemically dissolved gas may be quite high and alter significantly the glass properties.

On the other hand the physical dissolution of gases is only the lodging of the gases in the holes in the glass structure and can be easily taken out. The amount dissolved may not be very high as their placement is limited to the open space in the glass structure. The dissolution of the gas depends on the partial pressure of the ambient gas and follows Henry's law.

$$S = C.p$$

here, S is the solubility of a given gas in mole per Litre

p is the partial pressure of the particular gas in the ambient atmosphere in atm.

C is the solubility constant in mole per litre per atm.

In the case of glass melts this law is found to be obeyed at low pressure deviating from straight relation at high pressure due to the compressibility of the gas.

The oxidation potential of the glass melt is a combination of single bonded oxygen as conceived by acid base concept and by the dissolution of the gas in the melt especially chemical solubility.

Measurement of the oxidation potential of the glass melt: The measurement of the oxidation potential was so far indirect. Since the oxidation potential influences the redox state of the transition metal ions the ratio of the reduced to the oxidized species was considered as a measure of the redox state of the glass and since Fe is a common occurrence in glass the ratio of Fe^{++} to Fe^{+++} was taken as a measure of the redox state. The amount of the two valency states could be estimated chemically or spectrochemically. A direct measurement of the oxygen activity of the glass melt can now be made by the use of zirconia solid electrolyte electrolytic cell. On line measurement of the activity by electrolytic cell is now available and details of such equipment have been published in Vol 1, April-June 2007 of Kanch. A brief account of how such a cell works will only be given here.

Principle of measurement of oxygen potential by zirconia solid electrolyte electrochemical cell: Yttria stabilized cubic zirconia allows oxygen ion to pass through the solid at high temperature of around 1000°C and above. This transport of ion through the solid creates a potential difference between the two sides of a c-zirconia wall. The potential difference between the two sides is a measure of the difference in concentration of the Oxygen in the two sides of the wall. The cell may be written as

Pt. p_1O_2 I ZrO_2 I p_2O_2 .Pt

Where, the electrolyte is cubic zirconia. Two Pt electrodes may be soldered on the two sides of a Yttria stabilized cubic zironia tube. One side may be in the zone where oxygen potential is to be measures and the other side at a constant reference oxygen pressure which may be air for example.

When equilibrium is attained an emf is generated between the two electrodes obtained by Nernst equation and may be expressed in terms of the equilibrium constant K of the cell reaction.

$$nF\,E_T = -\Delta F = RTLnK$$
$$= RT \ln p_2O_2 / p_1O_2$$
$$\text{or } E_T = RT/nF \ln p_2O_2 / p_1O_2$$

where, ET is the emf generated at temperature T. n is 4, F is 96500 Coulobms/mole, Δ F is the change in free energy, and R is the gas constant. Therefore the measurement of the e.m.f at a given temperature (E_T) across the cell wall gives a measure of the oxygen partial pressure inside the tube if the outside is kept at a constant oxygen pressure. For measurement of oxygen partial pressure in the melt one electrode is dipped in the melt and the other is kept at a reference oxygen partial pressure outside the melt with a supply of gas from a cylinder. The location is usually at the forehearth. Therefore E is a measure of oxygen potential of the molten glass. However any counter voltage generated due to the difference in temperature between the melt and reference electrode which is kept outside the melt has to be corrected for.

Sulphur solubility in glass: Solubility of sulphur and phosphorous in silicate slags were the subject of elaborate studies in the decade of 1950 in connection with desulphurisation and dephosphorization of steel[1]. Calcium silicate and calcium aluminosilicate slags of interest to steel melting were equilibrated under controlled oxygen pressure obtained by using gas mixtures. The temperature range was from 1420°C to 1550°C. The solubility of sulphur was reported as weight percent SO_3 as it is also done today in glass science and it was observed that solubility increased in oxidizing atmosphere and also in reducing atmosphere there being a minimum at an oxygen pressure of around 10^{-4} to 10^{-6} atm.

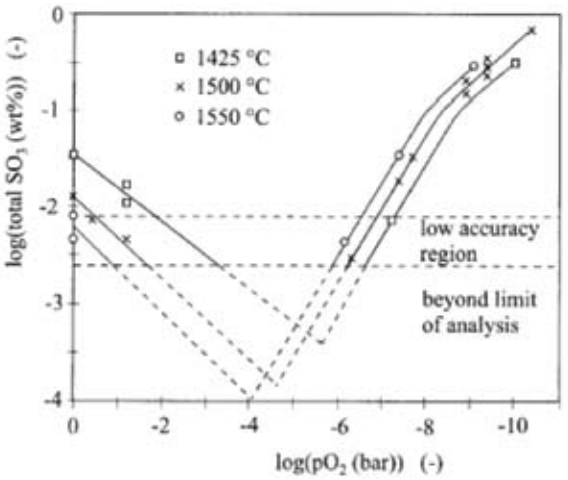


Fig. 1: Total equilibrium sulphur content expressed as wt. % SO_3 As per the work of ref 1. Calcium alumino silicate melt ($CaO\text{-}Al_2O_3\text{-}SiO_2$ in the wt % ratio of 37:27: 36) (ref. 1)

Work on soda-silica melts under reducing and oxidizing condition[2] showed the same phenomenon of a minimum solubility and around the same value for oxygen partial pressure. This is shown in Fig. 2. Sulphate sulphur is present at more oxidizing condition that is above a partial pressure of oxygen of greater that 10^{-6}. The sulphide sulphur starts appearing as the partial pressure becomes reducing i.e. at a partial pressure of 10^{-6} atm. and lower. As the temperature rises and the basicity of the melt rise due to increase in Na_2O content the sulphate appearance shifts to higher oxidizing condition

Valency states of S in glass. Most of the previous workers have identified two main valency states namely sulphate (S^{6+}) and sulphide (S^{2+}). However sulphur may assume valency states of S^{4+} (sulphite), S^{5+} (sulphonates).

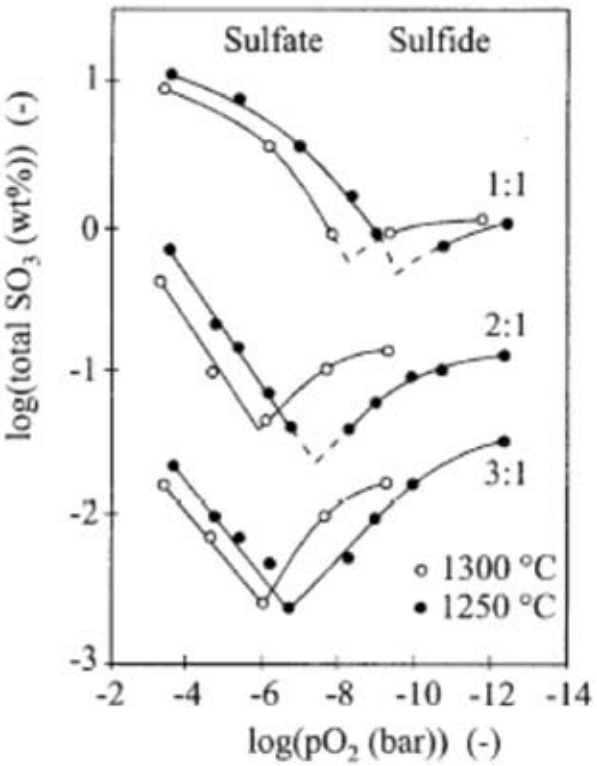


Fig. 2: Solubility of total sulphur expressed as wt.% SO_3 for SiO_2 - Na_2O melt of 3:1, 2:1 and 1:1 molar ratio (ref. 2).

Presence of S^{4+} (sulphite) in silicate glasses was revealed by many researchers. Similarly S^{5+} was detected in silicate glasses. However it appears that these two valency states are non-equilibrium phases and change to more oxidized and reduced species as the glass becomes more oxidizing or reducing. Even if they are present in commercial glasses the region of stability will be very narrow. Commercial glasses may be colourless, light olive, dark olive, light amber and dark amber. This happen when one moves from oxidizing to reducing atmosphere. Recently[3] using sophisticated experimental tools on commercial glasses it has been possible to identify the species S^{4+} and S^{5+} in the olive green glasses that appear at the minimum sulphur solubility region i.e. at the transition between oxidised to reduced state. It has also been found that sulphide sulphur in glass may not have the same surrounding as in crystalline sulphide.

The Fe^{2+} / Fe^{3+} ratio in melt and the sulphur solubility: The reduced to oxidized Fe ratio in glass may be measured on cooled glass chemically after decomposing the glass with hydrofluoric acid. It can also be measured by determining the optical absorption of the glass spectrophotometrically after grinding and polishing of a piece of cooled glass. Usually the absorption peaks at 380 nm for Fe^{3+} and 1000nm for Fe^{2+} are used. In case of amber and iron chromium green the 1050 nm absorption band of ferrous iron has to be used because of the overlap of the effect of S in the former and Cr in the later glass at 380nm. Extinction coefficient values may be used.

The ratio of Fe^{2+}/Fe^{3+} for a soda-lime- silica glass approximating the composition of industrial glass has been given in terms of optical density as[4]

$$0.133\ [(OD_{1000} - 0.036) / (OD_{380} - 0.036)]$$

Where, OD at a given wave length is $\log_{10}(1/T\lambda)$, where $T\lambda$ is the transmittance and λ is the wave length at which the transmission is measured. A simple spectrophotometric measurement of the polished sample is sufficient to measure the ratio. Instead of the partial pressure of oxygen the reduced to total iron may be taken as a measure of oxidation potential of the glass. A soda-lime-silica glass was studied for sulphur solubility by adding Na_2SO_4 for sulphur species[5]. The glass was allowed to go from the oxidizing to the reduced condition by the addition of carbon or aluminium. The Fe^{2+} /Fe total was measured at regular intervals as the glass became more and more reducing.

The sulphur content measured against the reducing condition as measured by the amount of Fe^{2+} is shown in Fig. 3.

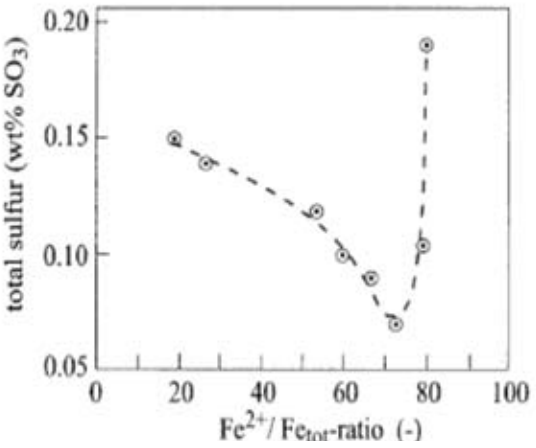


Fig. 3. Total sulphur solubility as SO_3 with the increase of Fe^{2+}/total Fe Or with the increase of reducing potential of the glass. (ref. 4)

It has similar eatures as described above. The solubility is high when the glass is very oxidising and it decreases as the glass becomes more reducing and a minimum is attained at Fe^{2+} of 70 percent. As the glass becomes more reducing the sulphur solubility increases rapidly because of the formation of Fe^{3+} -S complex which is the chromophor responsible for the amber colouration. The values given in Fig. 3 are not absolute values but depend on the glass matrix as well. A more

refined Fig.ure has been established later showing the effect of Na_2O on the glassy matrix and sulphur solubility against equilibrated oxygen pressure. The general feature however remains the same.

More recently[6] the sulphur solubility has been measured in industrial glasses with Na_2O varying from 13.8 wt% and 16 wt% at 1400°C and 1500°C against the oxygen partial pressure. The result is shown in Fig. 4. Sharp solubility of s occurs at p_{O2} of less than 10^{-6} producing amber colour and flint appears at PO_2 of greater than 10^{-4}. In between a reduced flint appear and sulphite (S^{4+}) is found to be the species. This measurement shows a broad minimum that shifts to higher oxygen potential as the temperature rise.

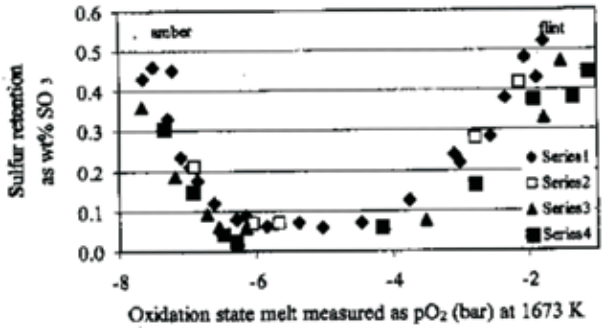


Fig. 4: Sulphur solubility Vs. oxidation potential for different Glasses refined at 1400°C (series 1,2, 3) and having 16 wt.% Na_2O (series 1 and 2) and 1500°C (series 4) (Ref: 6)

Mathematical modeling[7] has been carried out on sulphate – carbon system considering the following reactions occurring simultaneously in the melt.

$$SO_4^{2-}(m) \leftrightarrow 2SO_2(g) + O_2(g) + 2O^{2-}(m)$$
$$2/3SO_2(g) + 2/3\ O^{2-}(l) \leftrightarrow 2/3S^{2-}(m) + O_2(g)$$
$$SO_3^{2-}(m) \leftrightarrow SO_2(g) + O^{2-}(m)$$
$$CO_2(g) \leftrightarrow C(m) + O_2(g)$$

The temperature dependence of the equilibrium constant were measured or taken from literature. Calculation of the sulphur retention with Oxygen partial pressure is shown in Fig. 5. A shift in the minimum of the curve towards higher po_2 is evident at two temperatures of 1300°C and 1500°C.

The amber chromophore. The chromophor is tetrahedrally coordinated Fe^{3+} with three oxygen and one sulphur in the sulphide state[8]. This chromophor absorbs at 400-425 nm. In producing the amber colour more of carbon has to be added than needed for sulphate refining. This carbon preferentially reduces the sulphate rather

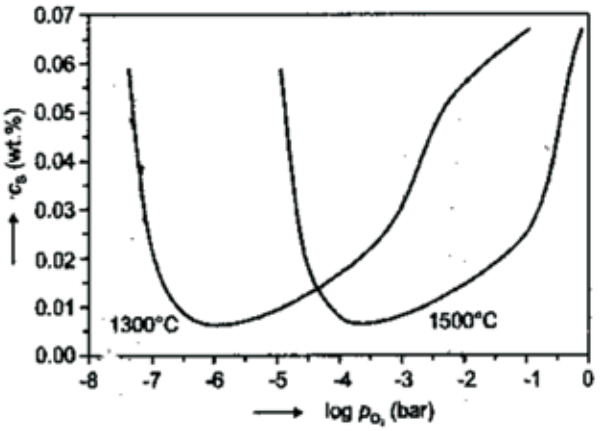
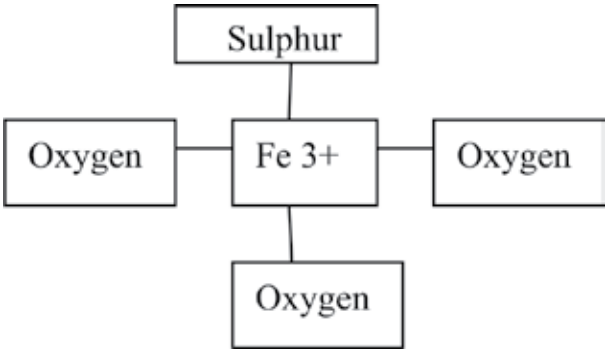


Fig. 5: The total sulphur concentration as SO_3 Vs. Redox state as measured by Oxygen pressure in atmosphere plotted as Log pO_2 (ref. 7)



than the iron as per following reactions

$$Na_2SO_4 + 1/2\ C \rightarrow Na_2O + SO_2 + 1/2CO_2$$
$$Na_2O + SO_2 + 3/2\ C \rightarrow Na_2S + 3/2\ CO_2$$

The excess part of the sulphate acts as an oxidizing agent and oxidizes the Fe in the Fe3+ state

$$6Fe^{2+} + SO_3^{2-} \rightarrow 6Fe^{3+} + S^{2-} + 3O^{2-}$$

The amber colour depends mainly on the redox state of the glass and does not depend on the type of raw material in the batch used to introduce sulphur for example pyrites, elemental S or Na_2SO_4.

The calculation of sulphur solubility and redox has been done under controlled laboratory condition and cannot be exactly equated with the industrial condition of melting. However the trend of sulphur solubility remains the same although the absolute values may differ. In industry a redox number is often calculated from the batch. Batch materials are classified as oxidising and reducing as per their chemical characters and a numerical value is assigned. This is done by considering the chemical oxygen demand during melting. Fig.ure 6 shows the relation of batch redox with sulphur solubility and the Fe^{2+}/Fe tot.

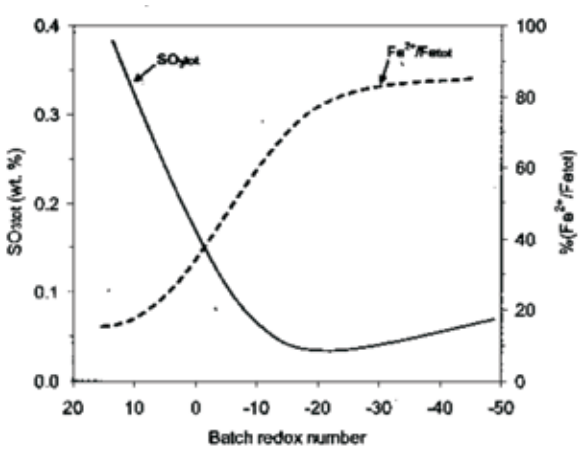


Fig. 6: Plot of batch redox Vs. percentage Fe^{2+} and solubility of S as SO^3

A summary of sulphur solubility, redox and the region of commercial glasses is presented in Fig. 7. The X-axis gives the redox number the negative side represents reducing and less negative side represents oxidizing condition of melting. The area where different types of glasses are melted and the valency states of sulphur has been indicated. The value on the X axis corresponds to a particular Fe^{2+} / Fe^{3+} Or Fe^{2+}/ Total Fe ratio (see Fig. 6).

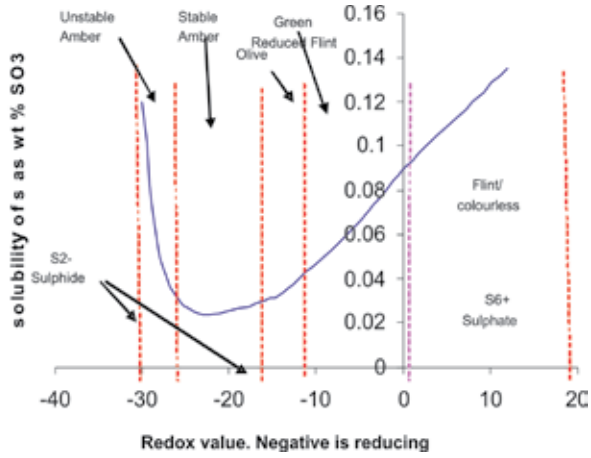


Fig. 7: A summary of Sulphur solubility and redox state of the glass showing areas of interest in glass melting.

Conclusion: Solubility of sulphur in silicate glasses is low and plays an important part in refining and formation of colour in glass. Sulphur in conjunction with iron in the oxidized state forms a chromophor that is responsible for production of amber colour. Here the iron is surrounded by three oxygen and one sulphur in the sulphide state in a tetrahedral geometry. There is a minimum solubility of sulphur at a given redox of the glass after which the solubility rises sharply forming amber colour. Between the amber and reduced flint an olive green colour may appear due to the formation of S^{5+} and S^{4+}. The very much reduced side of the curve has a steep slope and great care is needed to maintain a stable amber colour.

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

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BARBUS33, FEDWIRE/ROUTING NUMBER:

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Name	:	The All India Glass Manufacturers' Federation
Bank	:	Bank of Baroda
Branch	:	Parliament Street, New Delhi
City	:	New Delhi, India

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

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Name	:	The All India Glass Manufacturers' Federation
Bank	:	ICICI Bank Limited
Branch	:	9A, Phelps Building, Connaught Place, New Delhi
IFSC Code	:	ICIC0000007

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Advertise on AIGMF Website

AIGMF website: www.aigmf.com is an invaluable resource for visitors and offers a vast array of advertising opportunities. The website is promoted across entire Glass fraternity bringing many visitors to the site providing excellent exposure to your company's products and services. Advertisement will provide direct link to your company's website.

For more information on the available advertising options please send e-mail to info@aigmf.com

Special Feature

$1 Billion Worth Indian Container Glass Industry Gearing Up To Meet Demand

(Vinay Saran, HNG, Kolkata)

Glass packaging industry in India is buoyant with downstream demands from food & beverages, alcobev, pharmaceuticals and cosmetics industries. The industry is experiencing a huge surge in demand owing to the growing awareness about health and hygiene among the consumers. Continuous efforts by manufacturing companies to highlight the benefits of glass are also working wonders for the promotion of glass industry in India.

Indian container glass industry, which is currently estimated to be worth US$1 billion, is progressing with an approximate growth rate of 12%. Market analysis and research indicate that the trend will continue or even improve in the times to come due to rising disposable income and GDP rate. The Indian economy has been a major aid for the container glass industry enabling the industry to foster even during the worst financial crisis in history.

Indian container glass industry has long been a cottage industry resorting to rudimentary mouth- blown processes. The late 19th century saw the introduction of automated process wherein the glass industry evolved into a modern and hi-tech industry. The industry at present is one of the fastest growing segments in India with production strength of ~7,000 tons per day.

The Indian container glass industry is served by nearly 10 medium and large container glass manufacturers that contribute a sizeable share to its production strength. Many small manufacturers having petite furnaces (in the semi-unorganised sector) also add up to the installed capacity by over 500-600 TPD.

The container glass industry in India is a mature sector occupying more than 10 large and medium container glass manufacturers that supply packaging solutions to the various food and beverage, liquor, beer, pharmaceuticals, soft drinks and cosmetics companies. A key player in this segment is Hindusthan National Glass & Industries Ltd producing more than 15 million containers a day. We have an installed capacity of 2,825 TPD at present and plan to expand further with new facilities (both greenfield and brownfield) coming up in Andhra Pradesh and Maharashtra.

Naidupeta is one of the upcoming projects by HNG, which is set to be the largest glass hub in southeast Asia. The project is being set up with an initial cost of Rs. 700 crore and will house three container glass and two float glass plants.

Besides the large producers, Indian glass packaging industry also includes manufacturers from the semi/ unorganised sector. These manufacturers possess small furnaces contribute to over 500-600 metric ton per day.

Glass packaging remains a hot favourite owing to the several health benefits it has on the customers. Glass is chemically inert and does not pose any hazard on the health of the consumer is a major advantage that outranks glass among other modes of packaging available to the market.

Glass is also 100% natural and does not leach even when it is exposed to harsh chemicals. It is 100% recyclable; hence saves the earth from repeated Co_2 emissions. Glass also provides a premium image and enhances the visual appeal of the content, thereby fostering demand.

Glass has a longer shelf life and keeps the content safe and fit for consumption for a longer period of time. The transparency of glass allows the consumers the opportunity to see through the content and determine whether it suits their criterion.

Besides, glass is the only material rated as GRAS (Generally Regarded As Safe) by the US Food and Drug Association. It is deemed as an absolute choice for packaging edibles like food & beverage and soft drinks. Glass is also considered to be best packaging material for pharmaceuticals, alcobev and cosmetic production.

The Indian container glass industry is rapidly expanding owing to lower per capita consumption of glass.

(The writer is Senior Vice President, Hindusthan National Glass & Industries Ltd (HNG), a leading producer of container glass in India)

The industry is slated for even better performance in the coming years with new technologies and breakthrough innovations in the pipeline.

HNG is gearing up to address the rapidly increasing demand. We are building up capacities through greenfield and brownfield projects, as well as refurbishing our old furnaces to meet the market with full strength. We are also considering global technology tie-ups, in order to bring the latest technologies in India.

The latest launch from the HNG stable is the Narrow Neck Press & Blow (NNPB) technology, a revolutionary technology whereby the production of lightweight bottles with higher strength and better finish is possible. The NNPB technology facilitates the production of glass bottles which are over 20% lighter. It also ensures better control over glass distribution together with energy efficiency resulting in reduced carbon footprint and transportation cost of the finished materials.

After NNPB, we are planning to launch the Advanced Blow & Blow technology in India. It is another radical technology that is being successfully employed internationally for the production of glass container. At HNG, we are committed towards providing customised solutions to our clients and it is our enhanced customer-centricity that has strengthened our organisational focus towards market-driven innovations and transformations.

Glass Recycling uses less energy than manufacturing glass from sand, lime and soda

Environment Section

Successful Continuation of "Solar Meets Glass" Conference

The conference "Solar Meets Glass – 2nd Industry Summit for Quality, Logistics and Material" received positive feedback among over 150 delegates from the glass and solar industries on April 13, 2011.

The event, which had been organised by Messe Düsseldorf GmbH and Solarpraxis AG, formed part of the Photovoltaics Thin-Film Week, the world's biggest of its kind, which was held at the Berlin Adlershof Technology Park, from 11 to 15 April.

Other modules during this week were the Thin-Film Industry Forum, organised by Solarpraxis AG, the 2nd International Workshop on CIGS Solar Cell Technology, set up by PVcomB (the Thin-Film and Nanotechnology Competence Centre for Photovoltaics in Berlin), and the VDMA Annual Conference for Photovoltaics Production Equipment.

As well as providing an overview of the market and technology, "Solar Meets Glass" focused on the subjects of quality, logistics and materials – each with the purpose of discussing interfaces between the glass and solar industries. "This year we consciously decided to put the emphasis on thin-film PV, as glass is a material of absolutely vital importance for a variety of reasons. Thematically, this added up to an excellent event where delegates at the 'Solar Meets Glass' conference also benefited from the added value of other events at the Photovoltaics Thin-Film Week," said Hans Werner Reinhard, Deputy Managing Director at Messe Düsseldorf.

"We are pleased that by bundling various events during the Thin-Film Week this year we could create additional synergies, so that even more delegates came to Adlershof than last year. PVcomB, Messe Düsseldorf and VDMA complemented each other very well in the way in they worked together and addressed various target groups, so that the Photovoltaics Thin-Film Week is now even more widely known in the industry," said Karl-Heinz Remmers, CEO of Solarpraxis AG.

Delegates explicitly praised the "Solar Meets Glass" conference for providing a platform for an exchange between the solar and glass industries where burning issues and solution proposals could be discussed. Glass is one of the key elements for any future increase in efficiency and for cost reductions in photovoltaics.

Messe Düsseldorf and Solarpraxis AG are planning to work together again in 2012, when the next "Solar Meets Glass" conference will be held as part of the Photovoltaics Thin-Film Week at the Adlershof Technology Park in Berlin.

O-I Campaign Promotes Use Of Glass Packaging

CEOs, environmentalists, parents join "Glass Is Life" to share their love for glass and encourage brands to choose glass Owens-Illinois, Inc., the world's largest glass container manufacturer, announced the launch of Glass Is Life. This ground breaking marketing campaign is designed to showcase the unique and unmatched qualities of glass packaging to build successful food and beverage brands. A first-ever global initiative, O-I's Glass Is Life campaign also highlights the inherent love consumers have for glass.

"O-I's extensive research shows a strong demand for glass among consumers, but the marketplace does not adequately reflect this interest. We aim to influence the food and beverage industry's packaging decisions by showing the power of glass," said Al Stroucken, Chairman and CEO of O-I. "As the leading maker of the purest and most sustainable packaging, O-I is excited to spearhead a movement that demonstrates the unique attributes of glass packaging and brings brands back into glass."

Voices for Glass

CEOs, brand managers, environmentalists, designers, parents and other thought leaders around the world have rallied behind the campaign to share their passion for glass.

These voices for glass include:

Sanpellegrino S.p.A. Chairman and CEO Stefano Agostini, who says glass showcases the quality of the S. Pellegrino brand.

Monini Olive Oil CEO Zefferino Monini, who chooses glass because it best preserves the flavor of the product.

Environmentalist Celine Cousteau, granddaughter of Jacques Cousteau, who prefers glass because it is natural, healthy and sustainable.

True fruits Cofounder Nic Lecloux, who says glass demonstrates the quality and sophistication of his premium product.

Bundaberg Brewed Drinks CEO John McLean, who bottles his drinks in glass so it stands out on the shelf.

Agua del Nacimiento CEO Juan Gabriel Gonzalez, who says glass is the only packaging that shows the clarity and purity of Colombia's best water.

Consumers Know Glass is Better

Based on years of extensive business and consumer research, O-I has determined that taste, quality, health and sustainability represent the glass attributes that resonate most strongly with consumers around the world.

In a global study first commissioned by O-I in November 2008, consumers said that when faced with the option between glass and other packaging, they will choose glass first and would like to see more glass packaging options. For example, in the food category, 91 percent of consumers around the globe indicated they prefer glass, but only about 10 percent of foods are packaged in glass. O-I is working closely with customers around the world to increase the availability of food and beverage products in glass.

In the U.S., as recently as April 2011, nearly 70 percent of 1,000 Americans surveyed said that if they could purchase their favorite food or beverage in any container, they would choose glass. Additionally, 90 percent said they agree with the statement that glass is the healthiest packaging available because it does not leach into the product. And 85 percent said food and beverages taste better when packaged in glass containers.

"It's time to tell the world about the benefits of glass," said Erasmo Schutzer, vice president and chief marketing officer for O-I. "The thought leaders featured in O-I's Glass Is Life campaign are instrumental in helping us launch a more aggressive marketing strategy. Together we'll show how glass preserves flavor, maintains health, enhances quality, protects the environment and builds brands."

Glass Terminology

Anneal:	To prevent or remove objectionable stresses in glassware by controlled cooling
Binder (Fibrous Glass):	Substances employed to bond or hold the fibers together
Check:	An imperfection; a surface crack in a glass article
Devitrification:	Crystallization in glass
Fusion:	Joining by heat
Glass Ceramic:	A material melted and formed as a glass, then converted largely to a crystalline form by processes of controlled devitrification
Lampworking:	Forming glass articles from tubing and rod by heating in a gas flame
Seed:	An extremely small gaseous inclusion in glass
Stone:	An imperfection; crystalline contaminations in glass
Tempered Glass:	Glass that has been rapidly cooled under rigorous control from near its softening point to increase its mechanical and thermal strength
Weathering:	Attack of a glass surface by atmospheric elements

Optimise Coatings for Narrow Neck Plungers

Contributed by (Höganäs India Pvt.Ltd.)

Coating hollow glass moulds offers a range of benefits in bottle production, but finding the best combination of powder consumable and process for specific moulds is a complex challenge. In this article, Höganäs offers insight on an economical solution for coating narrow neck plungers.

Applying an optimised coating to a glass mould provides protection against wear and corrosion in an aggressive, high-temperature production environment. Protective coating is a cost-effective procedure, as increased wear resistance boosts productivity by extending the mould's operating life. However, each shape in glass production requires a unique mould with specific requirements for an optimised protective surfacing. Mould coatings may require not only different powder consumables, but also different application techniques. This is especially true for plungers and narrow neck plungers for the glass bottle industry, which come in a huge variety of different shapes.

A range of coating techniques is used to protect moulds. Thermal spraying methods such as flame spraying and HVOF (High Velocity Oxygen Fuel) techniques are commonly used on plungers. With a diameter of less than 25 mm, narrow neck plungers require hard and dense coatings. HVOF is normally chosen to coat narrow neck plungers. The technique uses a more concentrated flame than flame spraying, delivering powder particles at high speed to create high-density coatings. As HVOF is also an easily automated process requiring minimum machining before polishing, it offers a range of benefits to make it the most economical solution for coating narrow neck plungers.

The powder consumable and process parameters must be considered together to achieve excellent mould performance over an extended service life. Höganäs has long experience as a partner in the worldwide glass mould industry, helping to match the right power consumable and process for each application.

Find the right powder consumable

Choosing the right high-purity powder consumable is particularly important, as the HVOF process requires very fine powder. The most common solution is a powder with a particle size range of 20-53 micron, although some HVOF systems require even finer powders such as 15-45 micron.

Powder consumables with round particles can play an important role in achieving the required properties and efficiency for mould coating processes. As well as better flow, spherical particles enable processes with fewer fines and less clogging. Höganäs powder products are characterised by spherical particles without satellites and free from hollow spheres. The company has developed the Surfit™ range of powder consumables to cover the special requirements of thermal surfacing applications.

Optimise process parameters

The basic three-stage HVOF process is described below. However, optimising this process for specific moulds can be a complex challenge requiring wide-ranging expertise and research resources. Höganäs assists customers in the glass mould industry with services including metallographic analysis, extensive physical and chemical lab testing facilities to ensure excellent mould performance.

HVOF process for narrow neck plungers

1. Preheating

   For optimum results, preheat the coarsest sections of the plunger to 200-300°C to remove surface moisture.

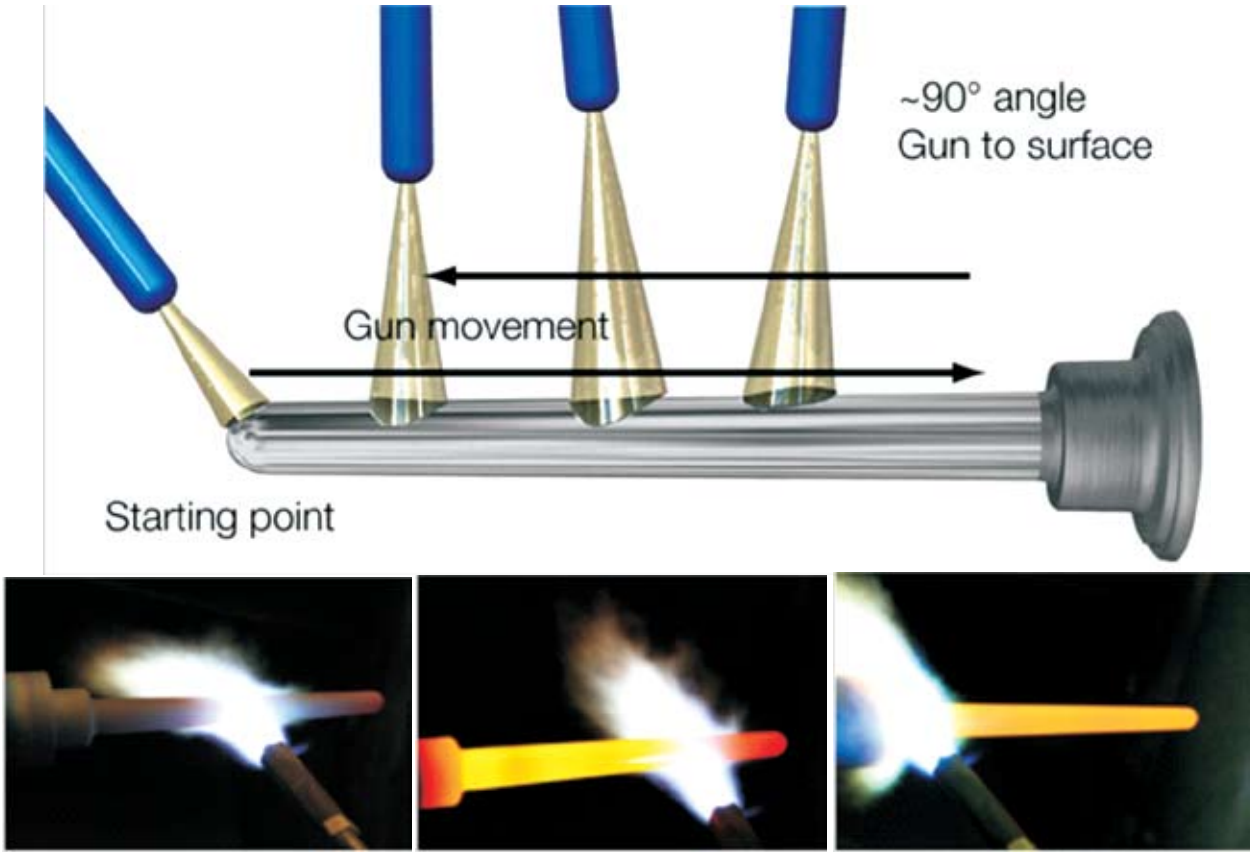
2. Spraying

   Starting at the top of the plunger, spray several layers of powder – about 8-10 passes are required to reach the normal coating thickness. The gun movement should be smooth, even and continuous – if the gun stops at any point, the coating will overheat.

3. Fusing

   Although fusing is not required for most HVOF coatings, fusing of coatings for narrow neck plungers is still recommended.

Selecting a fusing burner of the right size is important, e.g. a 1,000 l/min. burner capacity for small plungers and up to 4,000 l/min for large plungers. An inadequately sized burner may lead to an excessively long fusing time, resulting in an oxidized layer. A larger than required burner will overheat the layer, leading to failures such as sagging of the deposit, dilution, distorted base material and excessive fluxing.



Heat the plunger to about 900°C or slightly below the alloy melting temperature. Adjust the flame to acetylene gas surplus to produce a "soft flame". Start the fusing about 30 mm from the top. When the coating begins to shine like a mirror, move the flame towards the point of the plunger, and fuse that section first. Return to the starting point and complete the fusing of the plunger.

Recycling two bottles saves enough energy to boil water for five cups of tea.

Upcoming Events

Glass Build America 2011

Date: 12-14, September 2011
Location: Atlanta, Georgia
Contact: Glass Build America Show Management8200 Greensboro Drive, Suite 302, McLean, VA 22102-3881
Tel: +1 703/442-4890, ext. 300
Fax: 703/442-0082
Website: www.glassbuildamerica.com

Vitrum 2011

International trade show specializing in equipment and systems for flat, bent and hollow glass, with this edition focusing on the 'Green Economy'

Date: 26 – 29, October 2011
Location: Milan, Italy
Contact: Vitrum
Website: www.vitrum-milano.it

Glassman Turkey 2011

New addition to the Glassman series, featuring an exhibition of primary glassmaking equipment and services and an accompanying conference

Date: 22 – 23, November 2011
Location: Sheraton Hotel, Istanbul Turkey
Contact: Quartz Business Media
Tel: +44 (0)1737 855 133
Email: tammybreese@quartzltd.co.uk, kenclark@quartzltd.co.uk
Website: www.glassmanevents.com/turkey

Glasstech Asia 2011

8th international glass products, glass manufacturing, processing and materials exhibition

Date: 23 – 25, November 2011
Location: Jakarta, Indonesia
Contact: Conference & Exhibition Management Services Pte Ltd
Email: steven@cems.com.sg; aubrey@cems.com.sg
Website: www.glasstechasia.com.sg

Glass Tech International 2011

Date: 8-11, December 2011
Location: MMRDA Exhibition Centre, Bandar Kurla Complex, Mumbai
Website: www.zakglasstech.com

3rd GLASSPEX India 2013

Date: 20-22, March 2013
Location: MMRDA Exhibition Centre, Bandar Kurla Complex, Mumbai
Website: http://www.glasspex.com
E-mail: info@aigmf.com

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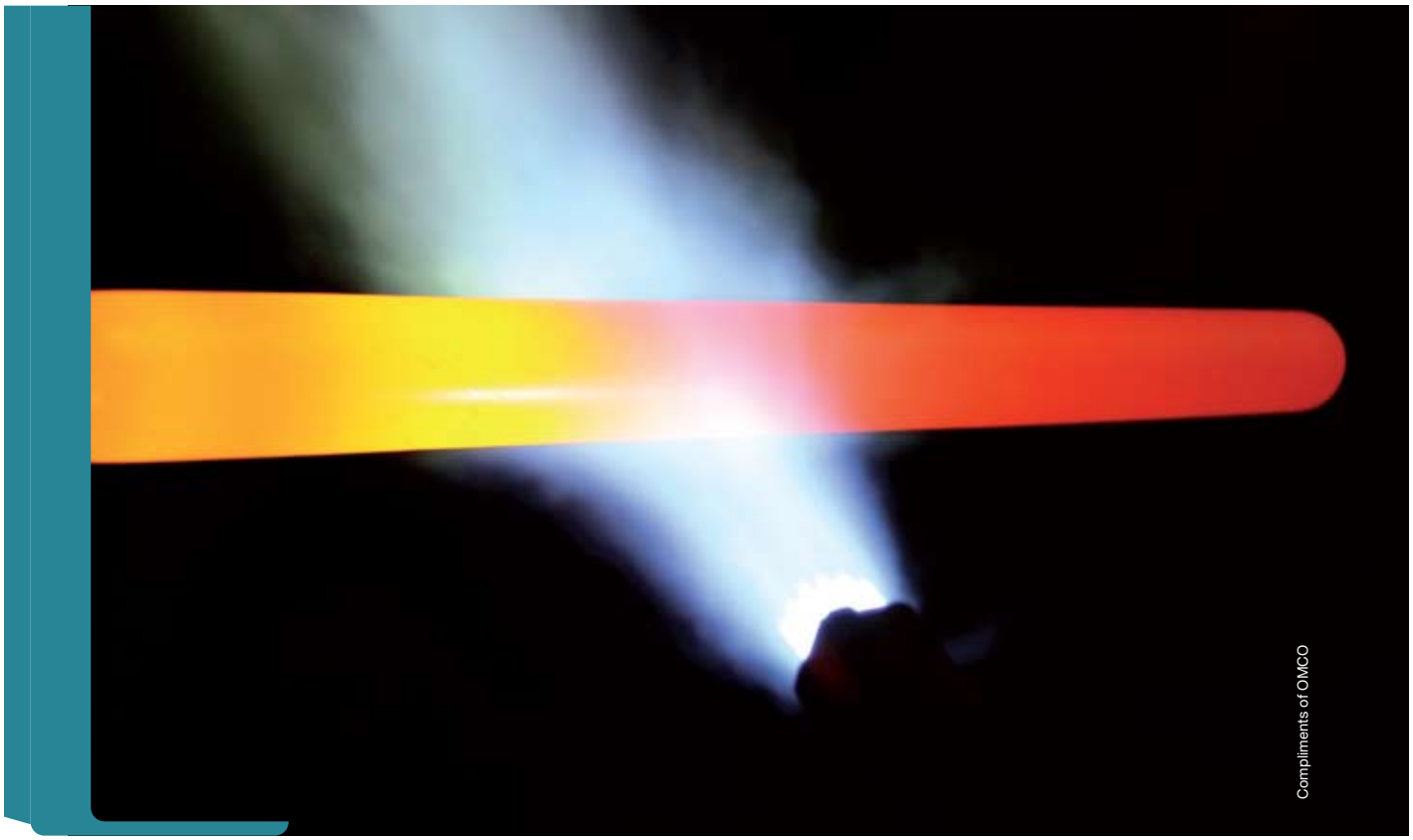

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