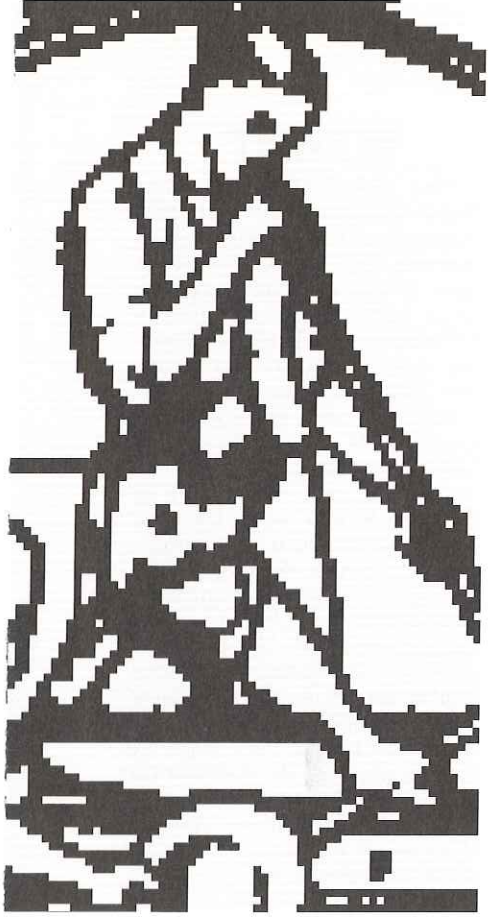

NO 2. 1994

SGT NEWS

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1994 GLASS SELLERS AWARDS

Entries are now being invited for the 1994 Glass Sellers Award for Art and Craft, presented by the Worshipful Company of Glass Sellers of London and administered by the Society of Glass Technology. Entries must be made predominantly of glass (but excluding stained glass windows) and have been created within two years of the official entry notice, 8 January 1994. The Award consists of an inscribed trophy and a cash sum of £1000.

This year, the Glass Sellers have extended their patronage to include a new biennial award to young artists and craftsmen at the beginning of their careers. Entrants for this category must be under 30 years of age on 8 January 1994, be studying at art school or college prior to graduation, or within three years of graduating.

The Award will take the form of an inscribed trophy and a cash sum of £500.

Short-listed candidates for both Awards will be invited to exhibit their work at The Livery Company Exhibition 1994, The Guild Hall, London on 12-14 July. Entry forms for both categories can be obtained from the Society.

MELTING PROBLEMS IN THE HAND-MADE GLASSWARE SECTOR

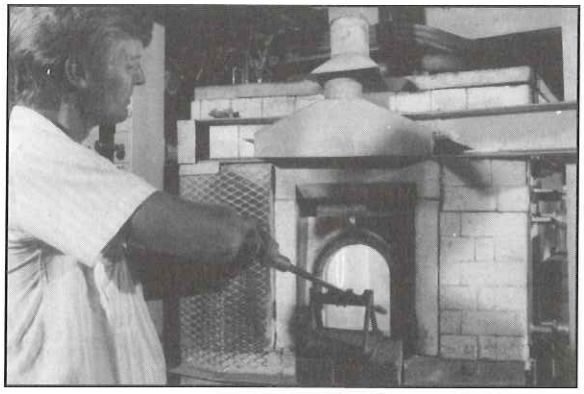
The Hand Made Glassware Committee's first ever clinic meeting was held at Pedmore House, Stourbridge in November 1993. The chosen theme for the day was melting problems, attracting contributions from 20 participants. The underlying issue was consistency for improved quality.

The human element is obviously an integral contribution to the manufacture of hand-made glassware. The fewer the number of outside influences on the workforce the better. A reliable glass to work with instills confidence, promoting overall quality. Maintaining this consistency throughout the melting process was the main source of discussion.

Single pot melting has diverse efficiencies but problems were noted in the quality of the refractory clays being used. A dark curtain of greenish brown was seen for clear soda lime compositions; this was due to iron oxides acting as a flux. Its presence meant that pots were being cycled round for production of coloured glasses much sooner than in the past.

Clay is a natural material and variations in composition have to be tolerated but when firing regimes are altered to cope with these variations, it becomes an issue. Rather than arching and letting the pots sinter in the furnace, they are now being prefired to 1400°C and even 1500°C on the inside surface to immobilise the excess iron.

TECO's semi-cold top electric tank prototype at Royal Brierley Crystal.



Filling the pot for the first time has been highlighted as a critical stage by Glafo, the Scandinavian glass research organisation. They recommended a minimum first fill

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and avoiding batching on top before the glass is fully melted. Otherwise, devitrification and quality problems will ensue.

The consensus on filling was that as many variations should be eliminated as possible, with a uniform temperature maintained across the top of the pot. Furthermore, batch and cullet have to be accurately weighed. Those who used a batch chute found it reduced the occurrence of stones.

Bagging allowed for even tighter control, reduced dust, saved on materials and was storable, although the design of the bagging system is influential. Moving the batch to the furnace also led to improvements in 'rugby passing' skills!

Pelletised batch, though popular with studio workers, was considered uneconomical in the current commercial climate, even though there was a higher yield of quality ware. Too many different batch formulations weighed against its use.

The 'feel' of glass as it is blown was debated. Is it just in the mind of the worker or are climatic conditions and cullet levels influences? A survey conducted by British Glass suggests that the workability of the same glass was perceived to be different by several sets of workers. Dissolved gases and water content may, however, have some influence but this has to be resolved. If moisture is a factor, it will be interesting to see what effect oxy-fuel firing has on workability.

Automatic suction gathering was praised for its contribution to ware quality. Avoiding splashes, ingress of cold air and adjustment to melt height were the potential problems.

The potential of new furnace types was briefly touched upon. The semi-cold top electric tank furnace prototype at Royal Brierley Crystal was said to be producing a very high proportion of first class, high value large pieces.

IN PRINT

The April 1994 issue of *Glass Technology* has the Eleventh Turner Memorial Lecture delivered by Hugh Tait. Feature articles are on future recycling trends, batch preheating and doghouse system design. Papers on corrosion processes, immobilisation of nuclear waste and chemical durability of copper phosphate glasses are also included.

***Physics and Chemistry of Glasses* has a selection of papers on sodium lanthanum silicate glasses, devitrification during melt cooling of infrared transmitting glasses, x-ray spectroscopy of zinc chloride glasses, volatilisation kinetics of phosphate melts, effects of gallium oxide on thermal and electrical properties, chaotic flow in glasses, dc conduction of glasses, structural changes in quenched tellurite glasses, effects of ion exchange on glass dissolution and boron coordination in borate glasses.**

Both journals have a wide range of abstracts from the latest scientific and technical publications.

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CONTROL OF SMALL AND MEDIUM SIZE FURNACES

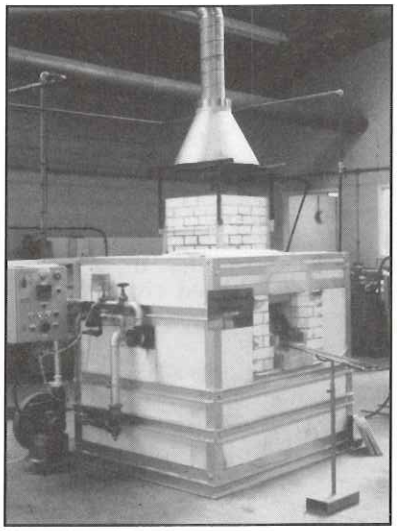
Control technologies are now available at a price which is well within the budget of even the smallest furnace user. MIKE TUFFEY of Sismey & Linforth led members of the North East Section through the product types available.

The function of a furnace is to generate, transfer and hold heat as efficiently as possible. Operational principles are well established, as is the shape and overall structure. Advances are now being made in control systems which can improve safety and the working environment while reducing running costs.

The simplest control system for a small furnace involves just a high/low setting which keeps the temperature within a predetermined band. More sophisticated studio furnaces of around 120kg capacity can have automatic temperature adjustment with proportional controllers and a back-loaded governor for the air and gas pressures.

An alarm system which telephones key personnel in emergencies means that the set-up can be left unattended. A standard single size closed pot furnace would have progressive temperature control, a recuperative burner system and lockable by-pass as back-up.

Sophisticated control systems may increase the overall capital investment in a furnace but operational costs are down. Fuel is burnt more efficiently, fewer combustibles are lost up the flue and less excess air enables better heat transfer. Safety and back-up systems allow for unattended overnight melting; no-one is needed as an overseer.



Sismey & Linforth day tank furnace, installed at Creative Glass of Kings Lynn.

Consistent temperature regimes can only be a further aid to better quality, reducing the potential for rejects. Environmental legislation, soon thought to affect even the smallest furnace, would also force emissions to be brought into line, strengthening the case for better control.

SGT NEWS

NEW RESEARCHERS FORUM

The opportunity to communicate early results on research work on glass and glass ceramics was taken up by a wide variety of young speakers at the Basic Science and Technology Committee's forum at Warwick University. The objective of increasing awareness of the range and variety of work going on in the UK proved to be a success.

The first session of the one day meeting looked at optical materials. David Furniss from the University of Sheffield presented a paper on the upconversion of near infrared diode laser light to blue or green light by erbium doped fluoride glasses. Potential end uses are in data storage, where greater compression can be achieved with blue or green light.

Ji Wang of University of Southampton is investigating the fabrication of optical fibres from GeO_2 and TeO_2 based glasses for optical fibres. These glasses lie between silica and ZBLAN and open up new opportunities for active and passive optical devices.

Tm^{+3} additives to ZBLAN fluoride glass and its effects on the activities of transition spectra were addressed by James McDougall of University of Paisley. Tm ions unlike Er and Ho did not influence the lifetime of the $^3F_4 \rightarrow {}^3H_6$ transition and 450 and 480nm (excitation) emissions were seen.

The final paper on optical materials by Paul Flower of Rutherford Appleton Laboratory was a report on the international search for a dense, radiation hard, scintillating glass for the large particle detector for fundamental atomic research work made at CERN.

Some $25m^3$ of glass is needed and a budget of £10 million is set aside for its procurement out of the detector cost of £900 million. A density of $6g/cm^3$ is needed and lead cannot be used because it inhibits the scintillation; cerium and barium are currently being investigated.

The second session concentrated on applied and industrial aspects. Roger Penlington from Sheffield Hallam University presented the first results of the simulation of thermal behaviour in the narrow neck press-and-blow plunger. The work links several simulation packages to visualise the distribution of heat on the plunger, in order to design improved air cooling flow patterns, leading to even temperature distribution and reduce areas of high wear.

Joe McGrath of the Atomic Weapons Establishment is investigating the effect of ageing on mechanical properties of chemically strengthened glass. Early results of various ion exchanged samples have shown that surface damage prior to treatment does not influence modulus of rupture.

Mark Jackson of Liverpool John Moores University described the effects of vitreous phase composition on the strength of bonded, high speed grinding wheels. The mechanical properties of the bonding phase are influenced by the glass network modifier content and this directly affects the safe operation of any high speed rotating body.

Float glass was the common theme of the third session. Jill Davidson from University of Aberdeen is investigating impedance of ion exchanged float glass, in order to monitor changes in the surface layer and diffusion within the glass. The comparative thickness of coatings can also be determined by this method.

Kyle Williams of University of Liverpool detailed collaborative research into the Mossbauer spectra of tin doped glasses. Variation in the recoil-free fraction of the spectra, the f-factor, may indicate that the Sn^{4+} and Sn^{2+} sites within the glass can be differentiated.

Tin oxide additions to $SnO\text{-}SiO_2$ glasses bring about discontinuities in physical properties which are being investigated by Mustamum Karim, University of Warwick. Localised high concentrations such as at the surface of float glass may see differences in softening points and a change in the role of tin from a modifier to an intermediate.

The fourth and final session looked at structure and applications. Bipin Patel from University of London is using sol-gel derived coatings to seal and restore teeth and customising a CO_2 laser system to consolidate the coating to a glassy state. The work

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GLASSES FOR OPTO-ELECTRONICS

A Special Interest Group of the Society has been formed to bridge the divide between glass scientists and those who use glasses in opto-electronic applications. The Group aims to bring together leading researchers from industry and academia to debate new areas of research and relate them to potential applications. Meetings organised by the Group will follow the established clinic format, with speakers making short presentations with plenty of time allowed for discussion.

Photosensitivity in glass is the subject chosen for the Group's first one day meeting to be held in March or April. Dr M G Scott of BNR Europe will host the event at Harlow, Essex. Drs Scott and Seddon of the University of Sheffield, together with Dr Townsend of the University of Southampton will be organising the programme.

Further details are available from Jill Costello at the Society.

LOCAL SECTION CONTACTS
For details of forthcoming local section events in your area, contact the appropriate Honorary Secretary.
All SGT members and non-members welcome.

London
– Mr M C Brew,
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Porters Wood,
St Albans,
Herts AL3 6NY.
Tel 0727 59261

Midlands
– Mr R W Fisher,
Sismey and Linforth,
Unit 94, Heming Rd,
Reddich, Worcester
B98 0AE.
Tel 0527 529810.

North East
– Mr J Henderson,
44 Woodside Ave,
Throckley, Newcastle upon Tyne NE15 9BE.
Tel 091 264 4775.

North West
– Dr D J Bridson, .
Pilkington Glass,
Prescot Rd, St Helens,
Merseyside
WA10 3TT.
Tel 0744 692358

Scottish
– Mr D A Rennie,
United Glass Ltd,
Glasshouse Loan,
Alloa FK20 1PD.
Tel 0259 218822.

Yorkshire
– Miss R M Sales,
20 Blackbrook Drive,
Sheffield S10 4LS.
Tel 0742 306179

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has progressed to in vivo evaluation of the metal alkoxide sol-gels; dentists will be using the process in two years.

Bridget Harris of the University of Aberdeen is using cobalt as a probe to determine the optical basicity of silver oxide-containing glasses. The empirical method will help understanding of the roles of ions in glass.

Martin Lockyer, University of Warwick is using nuclear magnetic resonance techniques to determine the bioactivity of glasses. The relative chemical activities of groupings of different species can be used to explain the behaviour of various glasses.

Amanda Nolte of University of Sheffield presented the final paper of the day. She compared the crystallisation routes of sol-gel and melt-derived $CaO\text{-}SiO_2$ glasses. Gel powders were found to initiate crystallisation at a lower temperature and showed greater sinterability than melt glass powders. ■

GLASS FOR LIGHTING APPLICATIONS

The Society was recently visited by Mr R K Bhardwaj, a member and senior project manager at the Lighting Division of Crompton Greaves Ltd, Baroda, India. He described some of the glasses used in lighting applications.

The glasses used in manufacturing incandescent and fluorescent lamps are basically designed to suit the sealing properties of the glass components with the dumet filament wire (Fe-40Ni). The shell is typically a soda lime glass with the composition (wt%) $72.5SiO_2$, $1.7Al_2O_3$, $16.0Na_2O$, $0.8K_2O$, 5.3CaO and 3.3MgO.

Lead glass is used for flare and exhaust tubings because of its good sealing properties and similar thermal expansion to the soda lime glass and other lamp components. Typical composition of lead glass is $63.0SiO_2$, $1.45Al_2O_3$, 21.0PbO, $6.88Na_2O$, $7.43K_2O$ and the balance a refining agent. The cost of the lead glass may be four times that of the soda glass but is very important.

Lead glass has a working range of 670°C - 1011°C, while the soda lime glass is between 703°C and 1014°C. The lead glass has a spread of about 341°C whereas the soda lime composition has a spread of only 311°C. This 30°C difference is very important where close control of glass viscosity is required.

One of the best examples of where close control of viscosity is required is in flare making. It is for this reason that lead glass is used. In flare making, the glass should be sufficiently hot so that it will flare out to the specified size. If the glass is too hot, it will tend to wrinkle and in extreme cases, lose shape completely. In the past, attempts have been made to run soda lime glass flares but because of its shorter working range, it was difficult to maintain good flare shape without constant attention to the machine fire settings. Hence soda lime glass is not considered suitable for production.

Another good example of where close control of glass is required is in the tipping operation. It is always advantageous to use the same glass for exhaust tubing and flares since they are sealed together in stem making operation.

The coefficient of thermal expansion of glass plays an important role in lamp manufacture. The components which are sealed together should have almost the same expansion characteristics. If the coefficients of expansion of the component glasses are too far apart, high stresses are developed which results in the glass cracking. Thermal expansion coefficients of lead and soda lime glasses are $94 \times 10^{-7}°C^{-1}$ and $96 \times 10^{-7}°C^{-1}$ respectively.

Although there is a difference of two points between these glasses, they are quite compatible for sealing. Consideration must be given to the choice of lead in wire, so that it will be compatible with flare glass to which it is sealed. The radial expansion of dumet wire is approximately $90 \times 10^{-7}°C^{-1}$. ■

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HOT END INSPECTION AND LINE EFFICIENCY

Feedback of quality information to the IS machine as quickly as possible will reduce the number of rejects. There may already be many thousands of containers out of specification before cold end inspection occurs after the lehr. Jorgen Laessoe Engineering has developed a vision inspection system for the hot end which cuts down the response time. PLM Redfearn installed the first system in November 1991. Two years on, the company hosted a presentation by Jorgen Laessoe to the Yorkshire Section.

Hot end inspection does not replace cold end inspection. Instead it provides a first filter, which helps correct defect sources from the IS machine. The Jorgen Laessoe vision-based system can only provide data on the sidewall, surface finish and check dimensional integrity. However, its position near the last section after coating means it can measure the performance of individual moulds.

Statistical information from the hot trend analyser can thus be used on graphical displays to show each mould's performance and alert the operator before critical thresholds are broken.

The system consists of a light box for background illumination and a camera in a protective housing. The computer is installed in the operator's room. A spacing of around 10% of the container diameter is needed and the throughput is 10 containers/sec.

Containers are examined from one viewing angle, so some 'leaners' for example will be missed but not enough samples to affect the reliability of statistical control.

The possibility of adjusting IS machine control parameters before production runs out of tolerances is an important factor in improving yield. Rather than waiting for faults to be seen by the cold end inspection equipment after the lehr, the hot end is informed almost instantaneously, saving many thousands of rejects.

The system installed at PLM Redfearn has improved line efficiency by 3% or 10 million containers over two years. Defects identified visually rather than dimensionally are rejected immediately and the risk of freaks being shipped to the customer is further reduced. Increased line speeds mean that handling has become more of a problem and arguments between hot end and cold ends over lost ware have increased. By continuously measuring the number of containers entering the lehr, the problem area can be identified. ■