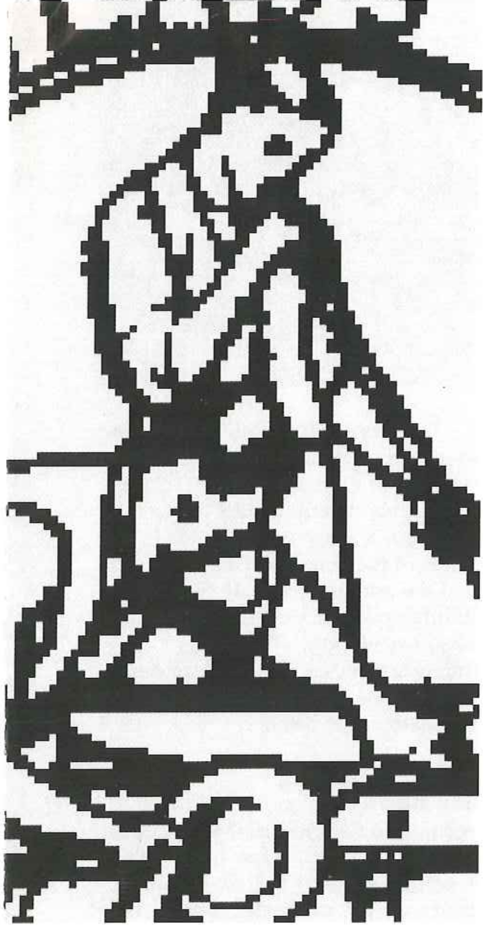

NO. 2 1996

SGT NEWS

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RECYCLED CULLET - ADVANCES AND CURRENT CONCERNS

Foreign or external cullet is making up a greater and greater proportion of the modern glass container batch. Roy Wright, a consultant in glass technology, has been heavily involved in cullet processing since the start of the UK bottle bank scheme in the late 1970s. He related the progress made in the collection and subsequent use of this material to the North East Section's meeting at GB Glass, Lemington.

In the late 1970s, Rockware started the first bottle bank schemes in Oxford and Northampton and in due course, a treatment plant was built at Knottingley. There is a misconception that this was the first serious use of recycled cullet. In fact Rockware had been using external glass from a number of cullet merchants at the Greenford factory in the 1960s.

The principal contaminant in amber was vulcanite screw stoppers used in beer bottles while in flint, it was drinking straws from the days of school milk and the aluminium caps. The amber was simply hand picked and crushed before use. The flint went through a washing process, followed by an air blow to remove the light materials before final crushing.

Today there are some 380 local authorities, 20 independent collectors, 18,500 sites with a total of 55,000 collecting units which in 1994 produced 404,000 tonnes of bottle cullet. This creates a recycling rate of about 30%, with a future target of 50% by the year 2000. Initiatives are in hand by the leading manufacturers to increase the rate through publicity and partnerships with some breweries to recover the large amount of glass arising from the sale of premium beers in clubs and public houses. In addition to bottle cullet, some companies also include recycled flat glass in their batch.

PROCESSING

Treatment techniques have improved over recent years in line with higher usage of recycled cullet. Magnetic materials are removed by the use of overband and fixed magnets. Light paper and plastic are removed by air suction, usually in conjunction with a screening system.

Optical systems are used which examine glass as it falls down an inclined glass plate, ejecting opaque materials with jets of air. The same air jet rejection system is used to remove non-magnetic metals after detection by an electro-magnetic device.

One or two manufacturers in the USA and France who do their own processing have adopted a quite different technique. This involves crushing the material in a rotary mill to a very small size. The method rests on the belief that ceramic material below a certain size will dissolve

CONTINUED ▶

IN PRINT

April *Glass Technology* has refereed papers on: Temperature development of glass during CO_2 laser irradiation - Part 1; study of commonly observed defects found during acid polishing of lead crystal glass; and the unusual optical properties of two Venetian glasses.

***Physics and Chemistry of Glasses* has refereed papers on: Electrical conduction mechanism in amorphous thin films of the system $Ge_{20}Be_xSe_{70-x}Te_{10}$; spectroscopic properties of Er^{3+} in fluorozirconate, germanate, tellurite and phosphate glasses; EPR study of defect formation and gamma-irradiation effects in Ge-S-Ga glasses; EPR and optical absorption spectra of VO^{2+} in $NaF.B_2O_3$ and $NaF.Na_2O.B_2O_3$ glasses; structural and magnetic properties of Fe_2O_3-P_2O_5-Na_2O glasses (Part 1) oxygen heat treatment; on the composition of the critical nucleus in phase separating glasses; chemical reaction of platinum with PbO-SiO_2 melt under DC electrolysis; and ultraviolet absorption and fluorescence spectra of cerium and the effect of glass composition.**

Each issue of *Glass Technology and Physics and Chemistry of Glasses* features an abstracts section with a survey of the latest publications on glass science and technology.

President:
Mr R Nickels, BSc, MInstE, CEng, FSGT, FIM.

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completely in the glass melt. Output from the mill is sieved and the coarse fraction is returned for further crushing. Contaminants build up in this coarse fraction and are discarded on a regular basis.

The product, by virtue of the process, is very fine and is not easy to handle, particularly if it should get wet. The melting implications of using large quantities of fine cullet are still not fully understood.

QUALITY

As the percentage of recycled cullet in use has increased, the quality has become of paramount importance. The contaminant which is of prime concern is the ceramic portion and loads will be rejected if they contain more than 150g/tonne of ceramic material.

Time and money are invested in educating local authorities by the processor and the glass manufacturer. This has proved effective in cutting down ceramic material and the consequent rejection.

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Current specification

Type:	Typical soda, lime, magnesia, silica glass.
Colours:	Flint: max 2% amber; green on a sliding scale according to usage.
Moisture:	No drainage.
Organics:	0.03%.
Magnetics:	0.005%, 50g/tonne.
Non-magnetics:	0.002%, 20g/tonne.
Inorganics:	0.002%, 20g/tonne.

The contaminant which has so far eluded the efforts of the processor and equipment manufacturer is glass ceramics. This had begun to appear in flat glass cullet as waste from the installation of stove and oven doors. It was possible by a process of visits, education and good housekeeping to eliminate this from the flat glass stream. However, it is also present in bottle cullet, particularly in amber as Visionware, the Corning glass ceramic formed into cookware.

Because the material is so different in its physico-chemical nature, it survives the melting process and appears in the final product as discrete glass knots. The difference in expansion coefficient is substantial, which leads to high stress around the inclusion. This is eventually sufficient to crack the glass, with or without external impact.

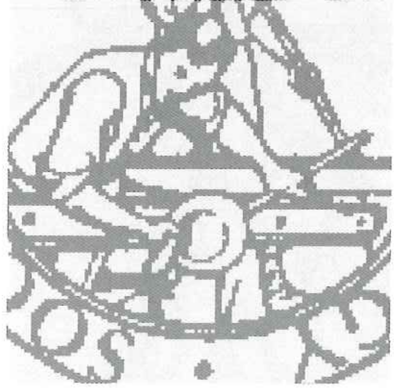
At one time the lead foil from wine bottles was a major contaminant which accumulated on the bottom of the furnace. From there it would readily find its way through the refractory joints and drip onto the steelwork. On occasion this could give rise to a problem if it created a path to earth from bottom electrodes. Great sheets of the material could be found at the end of the furnace life.

Aluminium foil, being more reactive with the glass produced discrete spheres of silicon as it reduced the silica to silicon. With the introduction of good separation techniques for non-magnetic metals, these are no longer a major problem.

REFINING AND REDOX

When only domestic cullet was in use, its presence in the batch was not given much consideration. The levels of refining agent in use were related to a standard amount such as 1000 parts of dry sand. When the concept of batch redox came into use, the presence of cullet was ignored in the calculation. In effect it was assigned the redox of the batch from which it came.

A moment's thought will expose the fallacy of this assumption. Carbon is added to amber batch, creating a significant negative redox. During the melting this carbon is totally consumed and does not appear in the glass. The glass must therefore have a much less negative redox than the batch from which it came. The various cullets each exhibit distinct redox behaviour, thus recycled green cullet will tend to be more reducing than the parent batch. Increasing the cullet without taking this into account will make the melting batch more reducing. This will increase the amount of ferrous iron present and move the colour from the yellow-green to blue-green.



With regard to refining, it can be more appropriate to consider the quantity of refining agents in relation to a tonne of melted glass rather than dry sand. A judgement is made in terms of the amount of SO_3 added and the amount retained. Since refining proceeds by the loss of an adequate amount of SO_3, the difference between the two amounts enables one to set the correct level of sulphate in the batch.

FOLK TALES

The most widely quoted tale in relation to the increased use of cullet is that it makes the glass more brittle. A second suggestion is that it has an adverse effect on the workability of the glass. There is no hard evidence to support either of these contentions. In fact in conversation with the works chemist using 100% cullet, he stated that the machine operators thought the workability improved by this practice. ■

TURNER MEMORIAL LECTURE

The 12th Turner Memorial Lecture will be presented by Professor J D Mackenzie of the Department of Materials Science and Engineering, University of California at 6pm on Tuesday 11 June 1996. Professor Mackenzie gave the 1995 Samuel R Scholes Memorial Lecture on the future of sol-gel technology to Alfred University.

The day of the Turner Lecture also marks the launch of the University's Centre for Glass Research and a restatement of Sheffield's commitment to all aspects of glass science and technology.

CLINIC MEETING ON CULLET

The Furnace and Refractories Committees are joining forces to organise a clinic meeting on the role increased levels of cullet are playing on the development of new refractories and furnace design. The meeting will be held on Wednesday 27 March at Pilkington Technology Centre, Lathom. Further details on this meeting can be obtained from the Society's office.

INTERNATIONAL SOL-GEL WORKSHOP

The dates of the International Sol-Gel Workshop, organised by the Society of Glass Technology, have been finalised. The meeting will be held from Sunday 31 August to Friday 5 September 1997 at Ranmoor Hall, Sheffield.

Dr Angela Seddon and Dr Peter James will be co-ordinating the timing and circulation of the first announcement which will be mailed out in the summer.

SGT NEWS

GLASS OPPORTUNITIES - THE CHALLENGE TO FURNACES AND REFRACTORIES

The Society's Spring Meeting looks at the opportunities and challenges that face furnaces and refractories. The meeting, to be held at the Ramside Hall Hotel in Durham, has been divided into three sessions, starting in the afternoon of 30 May and continuing on 31 May.

DAY 1 - AFTERNOON SESSION

Professor Jack Wenzel of Rutgers University will present a keynote address on glass - the material of choice for pharmaceutical packaging. Glass compositions, forming technology, coatings and quality in a clean room environment will all be discussed.

Lumonics use of flexible dot matrix laser technology to directly mark glass will be described by Keith Clark. There is great potential not only for applying serial and real-time information but also graphics. Printing as well as coating will also be one of the features explored in the development of automotive glass by Pilkington. Jeff Garner will develop this theme, as well as other trends in heating and shaping technology.

The second part of the afternoon session addresses the various aspects of oxy-fuel firing. Mike Damsell of Combustion Tec will put forward the view that oxy-fuel is not the panacea of all glassmakers' problems. The problem of deterioration of silica refractories in soda lime glass furnaces is one case which John LeBlanc of BOC Gases will discuss. He will explain how proper burners, burner placement and tight control on combustion can help avoid this problem. Moving away from melting, oxy-fuel-fired forehearths are helping to bring about greater temperature control and uniformity. A speaker from BHF (Engineering) will detail current design options.

DAY 2 - MORNING SESSION

British Glass' pilot transferred plasma arc melting furnace can produce about 1 tonne/day of glass. Jonathon Bentley will describe comparative tests with gas and electric melting and the use of ultrasound to physically refine the molten glass.

A thin coating of platinum or platinum alloys can go a long way to extending the service life of many refractories. Johnson Matthey's ACT coating provides an economic solution to refractory wear; Duncan Coupland will describe all. Joseph Chmelar of Glass Service will end the first half of the session with a description of computational modelling of glass inside the furnace.

The financial evaluation of new technology may be seen through traditional discounted cash flow techniques as low to negative returns in the early years followed by steeply rising returns after four or five years. John Green of Pilkington plc will present a more realistic evaluation, taking account of the complexities of technology, the route to market and competitive pressure.

Electric melting technologies will then be explained by a speaker from AFT. This will be followed by the presidential address by Roy Nickels. He will consider the role played by the vast range of companies that supply the glass manufacturer.

DAY 2 - AFTERNOON SESSION

The final session of the conference will bring two papers on crowns. Gerard Duvierre presents SEPR's solutions to the corrosion problems faced by silica, principally in oxy-fuel furnaces. Electrofused AZS and fused alumina placed at selected positions would prolong lifetimes and preserve quality. Professor Stan Lutskanov of Lubisol will then relate his company's experiences with monolithic, seamless, thermal insulation of the crown.

K Kannah provides an overview for large-scale melting under the EPA 90 regulations, explaining how emerging legislation may affect plans for future campaigns and the adoption of end-of-pipe or cleaner technologies.

Irish Glass Bottle is exploring the use of an end-of-pipe solution which also preheats cullet. Jim McGrath will describe the operation of the Edmeston electrostatic cullet bed filter and waste heat recovery system. The project is supported by British Glass and the European Commission, through the Thermie programme, is providing financial backing.

ADDITIONAL PROGRAMME

Before the start of the conference, two works visits are arranged. Delegates can either go to Philips Components or Newell. Philips is virtually over the road from the hotel in Durham. The site assembles TV tubes from supplied components. Newell took over from Corning Consumer in Sunderland. The site primarily produces heat-resistant cookware and remains the only company in the UK to operate an oxy-fuel furnace. ■

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

London
– Mr P West, United Glass Ltd, Porters Wood, St Albans, Herts AL3 6NY. Tel 01727 59261.

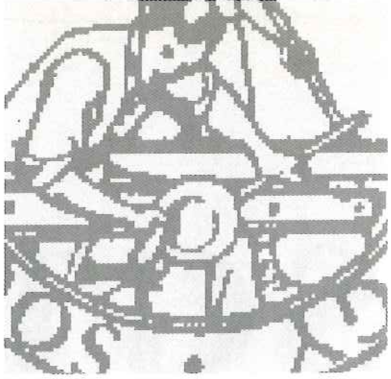
Midlands
– Mr C Baldwin, Stein Atkinson Stordy Ltd, Midland House, Ounsdale Road, Wombourne, Nr Wolverhampton WV5 8BY. Tel 01902 324000.

North East
– Mr J Henderson, 44 Woodside Ave, Throckley, Newcastle upon Tyne NE15 9BE. Tel 0191 264 4775.

North West
– Dr D Martlew, Pilkington Technology Centre, Hall Lane, Lathom, Ormskirk, Lancs. Tel 01695 54210.

Scottish
– Mr D A Rennie, United Glass Ltd, Glasshouse Loan, Alloa FK20 1PD. Tel 01259 218822.

Yorkshire
– Miss R M Sales, 20 Blackbrook Drive, Sheffield S10 4LS. Tel 0114 2306179.



MODERN AUTOMOTIVE GLASSES

With the ever-increasing use of glass in vehicles for aerodynamic styling and all-round visibility, designers are demanding higher performance products. Ken Fyles manager of the compositions and structure section at Pilkington Technology Centre, Lathom, highlighted the use of iron and other agents to produce tints for windscreens and sunroofs at a joint meeting of the Society's London Section and the Chilterns Engineering Materials Society, hosted by United Glass at Porters Wood, St Albans.

Modern vehicle styles demand low cost glass of aesthetically pleasing body tint and outstanding solar control properties to keep passengers cool and reduce air conditioning load. These properties are particularly important as glass areas in vehicles increase.

Ultraviolet is the most damaging. It is energetic enough to cause embrittlement of organic materials, fading of fabric colours, eye cataracts, sunburn and skin cancer. Visible radiation falls in a narrow wavelength band from 380nm to 770nm. Infrared is the region beyond the 770nm wavelength and transmits about half the heat through glass. The remainder of heat is transmitted almost entirely in the visible spectrum.

For the spectrum of normal clear float glass at 4mm thickness (normal motor trade thickness reference) much of the short wavelength ultraviolet radiation is absorbed due to the presence of ferric iron impurity and the infrared transmission is reduced by ferrous iron. Visible transmission is limited to about 90%, due to 4% reflection from each face and a little absorption by the iron. There is a legal requirement stating that at least 70% of visible light must be transmitted through car windscreens and 65% through the front side windows.

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ADDITIVE OPTIONS

As well as iron, other simple colourants used include: Cobalt - cheap, blue and cheerful; copper II - blue; erbium - not cheap, pink but without complicated valence states; neodymium - dichromic pink/blue; holmium - yellow; europium - orange/red; praseodymium - green; samarium - orange; and thulium - deep blue. Most of these are rare earth elements and are too expensive to be considered. More complicated multivalent colourants are: Vanadium; chromium; manganese; selenium; and nickel.

Vanadium confers similar transmission properties as iron to float glass since it colours glass green and gives both ultraviolet (V^{5+}) and infrared (V^{4+}) absorption. However, its effect on the infrared is much weaker than that of iron, limiting its use to ultraviolet absorbing glasses. A commercial example is UV Stop glass containing 0.2% V_2O_5 at very low iron content for use where high clarity but good ultraviolet protection is essential.

Chromium is more often used as a colourant in glass bottle manufacture since it has a high ultraviolet absorption and protects products from degradation. It has been proposed for modifying the colour and properties of automotive glasses but no commercial examples have yet been seen.

Manganese confers a purple pink colour to glasses at normal ferrous redox states and is a common colourant in spectacle lenses. Its use in flat glass has been limited due to difficulties of colour control.

Selenium is the third most widely used colourant for flat glass, after iron and cobalt, since it is the only relatively cheap material which absorbs in the 490nm region of the spectrum without the risk of solarisation. Its optical activity is very complex since the selenite and selenate forms are colourless and can predominate if the glass is too reduced or too oxidised.

The volatility of selenium is of great concern for manufacturers. Retention of selenium is enhanced by feeding an oxidised batch but this also encourages formation of the colourless selenates. At low ferrous states, selenium is better retained in the glass but is less optically active; at higher ferrous states, what little selenium remains has high optical activity.

Nickel oxide normally confers a yellow grey colour to flat glass. The glass colour changes slightly on heat treatment due to shifts in the relative proportion of six and four co-ordinated Ni^{2+}. Nickel has found favour in some recent automotive glasses.

Trends for privacy glazing in the rear of cars have created new colour opportunities, as have novel designs such as the Opel Tigra with its very large glass panel in the rear. Sundym 435 in the Tigra and Sundym 410 for sunroofs can cut visible light by 35% and 10% respectively.

Future automotive glasses may include more novel additives to cut infrared, while maintaining the achievements made in reducing ultraviolet. ■

EUROPEAN SOCIETY OF GLASS SCIENCE AND TECHNOLOGY

'Fundamentals of Glass Science and Technology,' the fourth ESG Conference, will be held in Växjö, Sweden on 9-12 June 1997. The meeting is also the Annual ICG Conference and the 47th Annual Meeting of the Scandinavian Society of Glass Technology.

Authors interested in presenting papers should submit their abstract by 10 June 1996. Papers should deal with any of the following subjects: Glass technology - raw materials; melting and furnace technology; quality control; energy saving; emission control; cold end processes and glass science/structure; properties and surfaces; special properties; crystallisation and phase separation; and relaxation.

All correspondence concerning the conference should be addressed to: Birgitta Holmdahl Ohlsson or Stellan Persson, Glafo, Box 3093, Växjö, Sweden. Tel +46 470 100 90. Fax +46 470 400 63. E-mail: post@glafo.se