SGT NEWS

ENVIRONMENTAL PROBLEMS AND THE GLASS INDUSTRY

The Environmental Protection Act of 1990 and more recently the Environment Act of 1995, with their associated regulations, have placed specific restrictions upon emission levels for many industrial processes. In particular, limits have been concentrated for aspects of glass manufacture and processes such as acid polishing.

The responsibility for enforcing the regulations is split between the Environment Agency and the local authority. Tim Glews, of the Environment Department, Dudley Metropolitan Borough, described his experiences with the local glass industry to a meeting of the Midlands Section at Pedmore House, Stourbridge.

Enforcement of the various UK and European environmental legislation of the last decade is split between three different organisations. The Health and Safety Executive is responsible for emissions within the workplace, lead in blood and control of substances hazardous to health. The Environment Agency, a conglomerate of National Rivers Authority, Her Majesty's Inspectorate for Pollution and the National Radiological Protection Board, is concerned with all aspects of pollution apart from emissions to air which is within the remit of the local authority.

There are 300 local authorities in the UK, all of which have enforcement capability and a responsibility to protect under the Environmental Protection Act (EPA), Part I Air and Part III General Nuisance. Part I Air is in part an addition to the clean air acts of the 1950s. The current government has set national quality standards for air, of which automobiles are the single main source of pollution. The initial targets were too harsh and were toned down. General nuisance covers a whole range of things, from noise and drains to donkeys being kept in high-rise flats and mattresses left in back gardens.

All local authorities charge £1280 to set up and authorise a prescribed process defined under EPA Part I. There is also an annual subsistence fee of £796 for a single prescribed process. If there are two processes, for example, acid polishing and gaseous emissions, then there will be two separate charges of the same amount. Separate sites for different processes would have to pay their own fees. The same scale of charges is applied across the whole of the European Union, though enforcement may be the responsibility of different parties.

Some industries have been slow to comply, while others have taken on their legal obligations. The glass industry has a good track record in the Dudley area, with one isolated case on failure to comply. By contrast, the foundry industry has been the opposite, dragging its feet on investment, which has resulted in the Environment Department being obliged to take legal action to enforce compliance. There is no excuse in law and failure to comply can lead to a fine for the

IN PRINT

The April issue of *Physics and Chemistry of Glasses* has peer reviewed papers on: refractive index structure relations in Li_2O–SiO_2 and Na_2O–SiO_2 glasses: a new approach to an old problem; oxidation states and co-ordination structures of iron ions in silicate melts during relaxation process and at equilibrium; effect of Sb_2O_3 and raw materials on the crystallisation of silver containing glasses; differences between the surface and bulk of glass melts, part 2; influence of redox ratio on the surface properties of silicate melts; optical absorption studies of free (H_2Pc) and rare earth (RePc) phthalocyanine doped borate glasses; crystallisation kinetics of a $2{\cdot}3Li_2O.1{\cdot}1ZrO_2.6{\cdot}6SiO_2$ glass; influence of particle size of glass powder on the crystallisation kinetic parameters of a fluorophosphate glass; X-ray diffraction study of MO–TeO_2 (M=Zn and Ba) glasses; phase separation and the properties of lithium calcium silicate glasses; colour development during devitrification in Li_2O–ZnO–Al_2O_3–SiO_2 glasses under conventional and microwave heating and a communication on crack speed in ultraporous brittle amorphous material.

The April issue of *Glass Technology* has peer review papers on: Hertzian contact of coated glasses; interaction between indentation cracks in soda–lime–silica glass; and glass melting using an IGBT full bridge resonant converter. The issue also has book reviews, Society news and feature articles.

Both publications have abstracts from the latest scientific, technical and business publications from around the world, giving a greater overview of the latest developments in glass.

The Society of Glass Technology has a commitment to authors to publish all refereed papers within nine months of their acceptance.

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 D Rewhorn,
Gorebond Ltd,
37 Manor Abbey Road,
Halesowen,
West Midlands.
Tel 0121 422 5425.

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.

NORTH AMERICA
– Dr A G Clare,
School of Ceramic Engineering and Sciences, New York State College of Ceramics at Alfred University,
2 Pine Street, Alfred,
NY 4802-1296, USA.
Tel 607 871 2392.

INDIA
– Dr J Mukerji,
Central Glass and Ceramic Research Institute, PO Jadavpur University, Calcutta 777 032, India. Tel 473 3496.

company, with individual directors being fined up to £20,000 and receiving a six-month prison sentence.

The lead crystal manufacturing industry in Dudley Metropolitan Borough comprises:

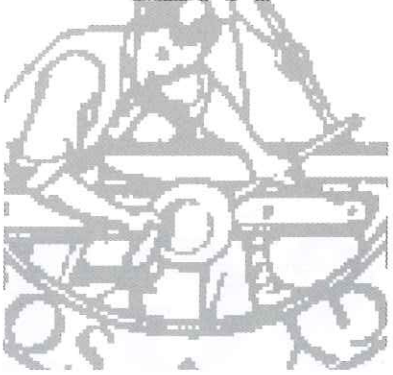
By process	
Manufacture only	2
Acid polish only	7
Manufacture and acid polish	4
Non-acid polish	1
By company size	
Small to medium	10
Medium to large	3

There are eight to 10 studios but they have not been counted in the full figures because their melting operations generally use lead cullet and they do not polish with hydrofluoric acid. The numbers in the area have stayed fairly stable over the last decade. The polishers who have entered and left the market have cancelled each other out.

For furnace emissions the critical point for compliance is the 1 October 2001 upgrading deadline. Lead and particulate emissions averaged out over the production cycle have been dealt with by the local industry. Open pots were the main problem but these have been replaced with closed pots. Fluoride and chloride emission sources from the batch have been adjusted to meet compliance targets, as have the measures for the combustion products SO_X and NO_X from the stack. Continuous monitoring of the stack can be achieved by probes of varying cost, depending on the overall accuracy and range of compounds to be monitored.

For acid polishing there were two deadlines, 1 October 1995 and 1 October 1999, to meet the HF standard. The target emission of 5mg/m^3 has proved to be difficult to comply with and the new and additional concern about SiF4 has also entered the debate. The measures needed to prevent excess HF emissions were a multiple tower acid fume scrubber for a large company, a smaller single packed tower for a small company and glass polishing without HF. Monitoring measures the total fluoride which includes SiF_4. Additional compliance time has been successfully negotiated for people in the industry to come to terms with measuring and controlling emissions of fluorine. Making an effort from the start provides for a more understanding and willing regulator.

Aspirations for BAT(NEEC) have been largely fulfilled by the glass industry, though the Environment Department has prosecuted others for their version called CATNIP, cheapest available technique not involving prosecution. ■



GLASS OPPORTUNITIES 2000 – MIXING TO MELTING

The Society's Spring Meeting, from 7 to 9 June at the World of Glass, St. Helens, will look at glassmaking issues from the mixing of batch to its conditioning.

The meeting begins on Wednesday with the traditional afternoon visits to local glass manufacturers or suppliers to the glass industry. There is also an additional option of a joint one-day meeting with the Ceramic and Glass Conservation Group of the UK Institute for Conservation. This meeting will look at modern conservation issues as well the historical influences glass manufacturing has had on the conservator's art. The meeting will provide a lively series of debates and give a common platform for the glassmaker and conservator.

The debate will continue into the evening reception where both sets of delegates will hear a talk from Gordon Kirk, the director of the World of Glass, on the establishment of the new visitor centre.

Thursday will begin with a keynote lecture on the quality of glass through mixing and melting by Dr Bill Pardoe, of Pilkington. The following session has papers on batch preheating by Dick Marshall, of BOC Gases, USA, optimising batch formulation and furnace operation by David Myers, of Appleby Calumite, USA, and a discussion on the standards for glass batch components by Margaret West, of Sheffield Hallam University, and John Osborn, of Beatson Clark.

The afternoon session begins with a talk on batch plant followed by Drs Gordon Richardson and John Parker presenting a joint paper on the many options for training and continued education. Dr David Martlew, of Pilkington, will present the last paper of the session, an evaluation of a Victorian glass tank furnace. After a short break the president, Mr John Clark, will deliver his presidential address followed by a short talk from the winner of the 1999 Student Project Prize and the Annual General Meeting of the Society of Glass Technology.

The conference dinner is to be held at the World of Glass that evening.

Friday morning begins with a look at the potential of glassmaking refractories by Geoff Evans, of GlassRef, followed by Alan Stephens, of BH-F, discussing glass conditioning improvements with computer-aided engineering and glass chemistry in the furnace by Professor Michael Cable, of Sheffield University.

The final session of the meeting begins with Ken Paul, of Emhart, discussing the effects of internal radiation and natural convection on glass conditioning. Richard Sims, of SORG, looks at flexibility in glass conditioning design. Finally Andy Hartley, of British Glass/Glass Technology-Services, talks on melting issues at the start of a new century.

The World of Glass is a new interactive learning centre for families, schoolchildren and the community. The centre is based on collections such as the Pilkington Glass Museum and uses a refurbished Victorian glassmaking furnace as its focus. The conference will use the centre's new meetings facilities. The St. Helens Stakis Hotel is next door to the World of Glass and other hotel accommodation is a short drive away.

For further information contact the conference department at the Society. ■

Compiled and published by dmg world media (uk) ltd on behalf of the Society of Glass Technology

APRIL 2000

SGT NEWS

Compiled and published by dmg world media (uk) ltd on behalf of the Society of Glass Technology

THE FUTURE OF GLASS

Glass manufacturers have to continue to innovate in the face of customer demand for better value while satisfying their shareholders. Picking winning innovations to the production process or new product lines is one of the ways in which prosperity can continue. Dr Phil Ramsay, the Foresight Programme Director for the Building Products Division of Pilkington, presented an overview of the flat glass industry and a glimpse of the potential future of float glass, to a joint meeting of the Society of Glass Technology North East Section and The Institute of Materials' Tyne and Wear Materials Society at the University of Newcastle.

The production of flat glass has steadily developed over the ages. The Pilkington name has been involved with flat glass making from the days of the crown process in the early 1800s. The crown process was slow and laborious but it did produce quite flat and quite reasonable quality glass. The more productive cylinder process succeeded the crown process. One long bubble was blown which was then opened and flattened and quality was improved. Plate glass was made by casting molten glass onto a flat bed. The quality of this glass was not very good so it had to be ground and polished. Workers with clogs would shuffle or 'swim' on the surface of the glass with gradually reducing grades of abrasive and rouge was used as the final polish.

The PPG process involves the drawing of a molten glass sheet upwards, and as it solidifies it is cut. This was almost a continuous process but there were particular safety aspects relating to the breaking of the sheet as it was drawn. Doctors were available in the plant at all times in case of serious accidents.

Pilkington had grown with the increased market for glass and by the time it took over Chance Brothers it dominated the UK flat glass industry. In 1959 the Float Process revolutionised the production of flat glass and a truly continuous manufacturing process came into existence. The company licensed the process to companies around the world and used the income from the proceeds to acquire footholds in Europe and the USA. In the 1980s Pilkington was the world leader in flat glass production mainly due to the float process, however, Asahi Glass is now slightly bigger. The company's growth involved diversification into many different product areas, but recent retrenchment has seen a stronger focus on the core markets of building and automotive with a total £2 billion turnover. The reasons for splitting between the two core markets relate to the different customers. The building market has a fragmented customer base, whereas automotive has a reducing number of very large companies.

The competition to glass comes from plastics. Plastics such as polycarbonate offer reduced weight, better fracture resistance and formability. Glass, however, has better stiffness, durability

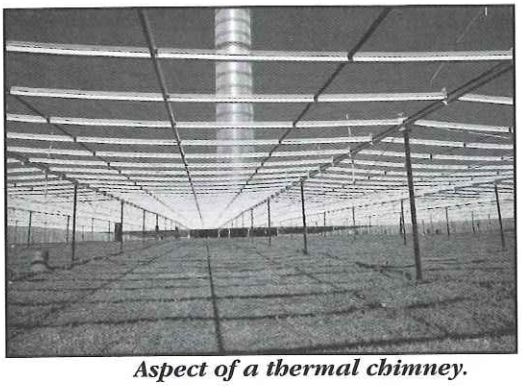
CONTINUED ▶

ICG 2001 UPDATE

The organising committee for the 19th International Congress on Glass met at the conference venue earlier this year to familiarise itself with the Edinburgh International Conference Centre. The Conference Centre is very well situated at the west end of Princes Street and has a good spread of rooms of different sizes to hold parallel sessions. The Pentland Auditorium, the main conference room, has a unique feature. It can hold a total of 1400 people, but can be split into three separate rooms by the simple rotation of two sections to split the seating into one large area seating 800 and two smaller rooms of 300 each. The EICC has several hotels close by as well as some new sites due for completion in 2000. The organising committee considered the final aspects of the social programme with only the venue for the conference banquet to be finalised.

Professor Adrian Wright, the chair of the programme committee, is in the process of identifying a list of invited speakers and members of his committee have been appointed to build up the technical programme and coordinate with related interest groups. The papers from the invited speakers will appear in issues of *Glass Technology* and *Physics and Chemistry of Glasses* for the start of the meeting, along with a volume of extended abstracts for the remaining papers from the conference. The conference proceedings will be refereed after the meeting and published in special conference volumes of *Glass Technology* and *Physics and Chemistry of Glasses*. The programme will be circulated before the start of the meeting and updated on the Society's website.

The 19th International Congress on Glass (ICG) will be held in Edinburgh from 1-7 July 2001.



Aspect of a thermal chimney.

and cost. Plastic windows in cars are a possibility, especially in high positions to reduce the centre of gravity of the vehicle. Polycarbonate with an abrasion resistant coating is making small inroads in the very small windows business but for the moment glass remains the preferred material for large areas.

The float process has been through its major development and there are only minor improvements to the overall principle, but there are many areas where Pilkington is developing new initiatives.

Wheel scoring of glass has been the same for more than 50 years with the only improvement having been the introduction of the more durable diamond wheels, rather than tungsten carbide. However laser scoring is close to being introduced. Thermal stresses are introduced by CO_2 laser before the glass is bent to separate the cut items and there is less likelihood of damage away from the cut. The laser is not quite quick enough to be a match for the cutting wheel, but there are still possible improvements to be made.

On-line coatings using chemical vapour deposition, physical vapour deposition and sputtering are offering further enhancements to the properties of raw glass. The K coating was one way to prevent heat from being radiated out of a building in cold climates. The anti-K coating blocked heat from coming into a building in hot climates. The Reflex on-line mirror coating system was a great idea, offering an instant mirror straight from the float line. Unfortunately yields of the coating were low because of small pin holes in the coating.

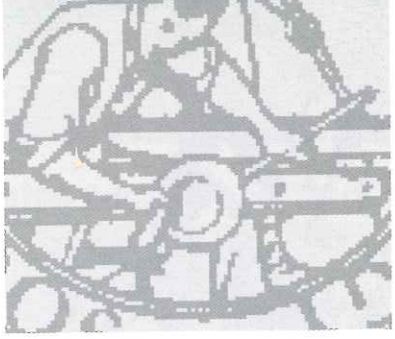
The research and development process within Pilkington has been structured to pull in the different disciplines, such as scientists, engineers, marketing and accounts, into teams. The process or product development then follows five steps: concept definition, evaluation, development, implementation and launch, with four 'stage gates' to pass before it can reach the final stage.

One recent project has been an investigation into reducing the cost of the batch materials. Raw materials are the biggest cost component in the manufacture of glass, and soda ash is the most expensive material within the batch. Manpower is a very small proportion and fuel costs have reduced with the move towards gas and greater efficiency. Reducing the soda ash content increases the processing temperature for toughening, however, and this would differentiate the Pilkington glass from its competitors. Inertia and resistance from the customer base for a marginally lower cost product has not proved to be sufficient for further investigation.

Electrochromic coating on glass has proved to be a great success. The Stadtsparkasse, Dresden, was the first building to introduce a glass which changes colour from clear to blue over a ten min switching time. Transmission of light is reduced by 50% to 10%. The first generation electrochromic installations had a thick laminated structure which was protected from degradation by being on the inside of a double glazed unit. Second generation electrochromic glass installations will be on a single piece of glass with the four coatings applied off line by sputtering onto K glass. The aim is for a 20 year product life with no shorting of the circuit between the layers. A long term aim is for installation in cars.

A variable mirror that can switch between a transparent window has many applications. A rear view mirror in a car, which detects dazzling light from behind and automatically dims, has been licensed. Reflective windscreens have begun to appear on some French car models, rather than the established body tinted solar control glasses that were used to prevent overheating until now. The heat is reflected from the glass rather than absorbing it, so a breeze is not needed to cool the glass. The cost of entry into this new market is high, however, with around £20 million needed for the coating plant. Interest from other motor manufacturers is needed before such expenditure is justifiable.

Hydrophobic silica coatings on the surface of glass stay totally dry and could dispense with the need to have windscreen wipers in the long



term. At the moment they are only acceptable for side windows, as their resistance to wiper abrasion needs to be improved, since speed is required to remove the repelled water.

New markets for flat glass are opening up in displays, hard disks in disk drives, load speakers, solar cell modules and solar thermal energy. Flat panel displays such as plasma screens or liquid crystal displays are becoming more common in the workplace. To really gain a foothold in the market float glass would have to be used. The main problem is the sodium content of ordinary float glass. The sodium ions leach out from the surface and react with the electronics behind the screen. More development is needed in controlling the mobility of alkali ions from the glass surface.

Glass is a perfect substrate for the platter of hard disks for computer disk drives. Aluminium is the dominant material currently but is being challenged by glass in laptop and desktop machines.

Any flat material can vibrate and form a loudspeaker with the right stimulation. NXT makes such speakers and has used glass in all its different forms in a typical room to produce sound, picture frames, mirrors, even windows! Solar cell modules will use flat glass as the protective outer layer.

An idea that has been around since 1977 is the solar chimney. A sea of glass, raised 2m above the ground, surrounds a tall tower (maybe 1000m) the air warmed under the glass is drawn up the middle of the chimney and used to drive a turbine for electricity generation. There are plans for a 1.5km high tower with 7km^2 of glass surrounding it to be built in South Africa in 2004. A project of this scale could feasibly have its own dedicated float line to supply the glass!

Glass may be a mature commodity product but there is always the potential for interesting new products and innovations. Pilkington is working to develop glass and its manufacture within defined boundaries and maintain its position as a major player in glass manufacture. ■

Society of Glass Technology,
3rd Floor,
Don Valley House,
Savile Street East,
Sheffield S4 7UQ.
Tel 0114 263 4455.
Fax 0114 263 4411.