SGT NEWS

REFRACTORY DEVELOPMENTS UNDER THE SPOTLIGHT

Choosing the best material for components within a glass furnace requires an appreciation of the range of properties needed and the potential of refractories engineering. David A Jarvis of Liptak Bradley detailed their use in three different areas at the North West Section's first meeting of 1993, held jointly with the Institute of Materials.

Refractories in this context are inorganic non-metallic materials, often oxides with a melting point in excess of 1000°C. Their physical form may be that of bricks, blocks, slabs, monolithics or even that of low thermal mass materials with cellular, laminar or fibrous structure.

The examples chosen incorporate refractories in systems where they are used not only to contain heat but also to store and transmit heat, which is transferred by a combination of conduction, convection and radiation.

In the first example, the refractory system is enhanced to prevent the maximum amount of heat loss from the structure. In a glass tank regenerator, process heat is abstracted from waste gases and used to preheat combustion air to increase the efficiency and decrease costs. This heat exchange takes place within packings contained by the regenerator structure, which take relatively little part in the exchange. The structure itself, however, suffers significant heat losses.

For the purpose of analysis, the regenerator structure can be divided vertically into three or four zones, dependent on the temperature in each sector. Each zone would normally have a different lining configuration to withstand not only the temperature but also the mechanical load and any possible chemical attack.

The outer layers of each zone of the structure may or may not consist of insulating refractories but would certainly have a lower thermal conductivity than the hot face layer at the same level. It is therefore common to add optional additional insulation to the external surfaces of regenerator walls. Traditionally, this can take many forms, including firebrick, slab, gun mix, plaster or spray.

When these options are considered from the point of view of thermal conductivity, then insulating gun mix, although good in terms of other materials, is generally the highest and therefore the worst insulator. Insulating firebrick is next highest. Those with the lowest conductivity are insulating boards and fibre monolithics.

When other factors such as the cost, ease of installation, effectiveness of the seal and life are considered, fibre-based sprays with refractory fillers and binders win out on almost every evaluation. This insulation spray or Inspray can be applied to an even thickness, usually about 50mm to an homogeneous density of 300kgm^3 and retained, if necessary, on appropriate anchor systems. Spray is not applied to channels, buckstays, skewbacks or crown and may not be applied to wickets or observation ports.

On a medium-sized container glass tank, heat losses through the regenerator structure can be reduced by an average of 45%. This can equate to total fuel savings of up to 15%. On a large flat glass furnace, the application of Inspray can reduce heat losses by an average of 30%, equating to total savings of the order of up to 10%.

On crystal glass pot furnaces, the savings can be as high as 60% because the insulation can be applied on both hot and cold faces simultaneously where they are of closed pot design. Research has shown that such insulation has good mechanical strength for its class and experience confirms that small repairs can easily be made when required.

CONTINUED ▶

GLASS MELTING EMPHASIS

The Spring Meeting of the Society of Glass Technology on May 12-14 at Shifnal will look at the present, potential, problems and solutions of glass melting.

Batch, melting, conditioning and pollution make up the subject areas to be covered by a range of contributors from refractory, furnace, container and float industries. A clinic will debate the issues raised by the papers on pollution. The keynote paper on innovation in glass melting will be presented by Mr J L Barton of Saint Gobain Recherche.

The annual general meeting of the Society on the afternoon of May 14 is preceded by the Presidential Address by Mr N M McDonnell. This will be followed in the evening by the annual dinner and dance.

For further details please contact Jill Costello, Society of Glass Technology, 20 Hallam Gate Rd, Sheffield S10 5BT, UK.

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, United Glass Ltd, Porters Wood, St Albans, Herts AL3 6NY. Tel 0727 59261.

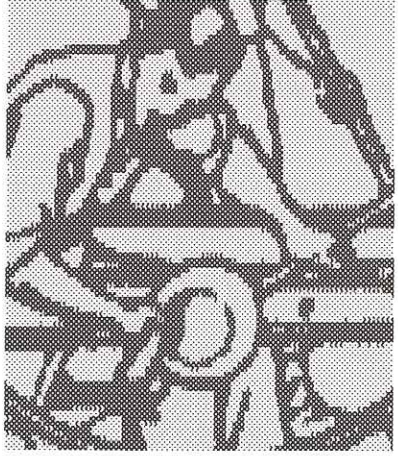
Midlands
– Dr G R Mattocks, 'Whitemead', 18 Blakebrook, Kidderminster, West Midlands DY11 6AP. Tel 0562 824153.

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

North West
– Dr D Martlew, Pilkington Technology Centre, Hall Lane, Lathom, Ormskirk, Lancs L40 5UF. Tel 0695 54210.

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.



CONTINUED ▶

In the second example, it is useful to consider the regenerator packing as a refractory which must have a high thermal mass and also enable heat transfer to take place at relatively high speed. Chemically, the refractory must resist batch and fuel element attack. Physically, it must retain its shape, being neither eroded nor accreted or deformed during its life. It normally has a very high melting point, high density and high stability.

The shape and size of the packing affects the volume of the regenerator, the effective surface area for heat transfer and mechanical stability of the setting. Many combinations are possible, from simple rectangles through tongue and groove blocks, polygons and cruciforms.

At least one refractories supplier has introduced a corrugation into vertical surfaces of chequers which improves convective heat transfer. Performance increases of 20% have been claimed as a result of these improvements. One thing all suppliers have done is to combine maximum density with minimum section thickness. This increases the heat content of the block, as well as the rate of heat transfer quite dramatically!

As a third example of how thermal and refractory properties can be engineered into an efficient system, it is worth considering the charge end wall on larger furnaces. This wall could be up to 12m long and up to 6m high. Since the glass batch is ideally charged over the entire width of the furnace, the wall is fully suspended by heat-resistant castings onto the main furnace steelwork. The nose or toe at the bottom of the wall, where maximum wear occurs, is ideally suspended separately to the main wall. It may be raked back to increase the melting rate by radiation back into the batch.

The refractories in the wall should resist chemical corrosion, as well as very high temperatures. They should be moderately dense but not too heavy since they are suspended onto the beams. They should be thick enough to contain the furnace heat for a long campaign life but thin enough to be economic. The refractory should be relatively volume stable at very high temperatures.

The optimum solution is provided by a 275mm thick high purity silica refractory. Each brick or pair of bricks is suspended on heat-resistant nickel chrome castings onto the sub-assemblies, which are fitted to the mild steel furnace beams. The back of the beams are then plated and fans are used to blow air down between the plates and the cold face of the refractory.

This same air also circulates around the heat-resistant castings to keep them at low temperatures, even when the hot face of the refractory is up to 1600°C. When the furnace is first heated, the volume of cooling air is slowly increased so that sufficient air is available to keep the courses of brick from fusing but not enough to bleed into the furnace.

This balance is assisted by careful installation of exactly the correct expansion allowances into the horizontal courses. Lateral expansion can be accommodated by mounting the top beam on rollers. The nose may, if necessary, have different expansion allowances.

The effect of combining high quality refractory bricks with detailed refractories engineering and precise installation and commissioning is to provide optimum performance, economy and life. The cooling air which is passed down the cold face of the refractories and is in the process heated is then ducted off and used as preheated secondary combustion air to recover most of the sensible heat.

These examples are intended to illustrate how the development of refractories is not an accident or a lottery but is the result of co-operative work between major suppliers and end users. It is also normally a total refractories engineering package to provide a solution to a problem. By applying fundamental principles of chemistry, physics and mathematics, practical systems incorporating the best materials, good design and competent installation give the user optimum performance at an acceptable cost.

Compiled and published by FMJ International Publications Ltd on behalf of the Society of Glass Technology

TURNER MUSEUM MOSAIC APPEAL

Exhibits from the Turner Museum at 'Elmfield' have been moved to a site within the Sir Robert Hadfield Building, following the relocation of the University of Sheffield's Department of Engineering Materials. In preparing for the move, the centrepiece exhibit, the Turner Mosaic, was found to be in need of repair. The plaster backing which originally fixed the mosaic to two slate beds had separated in several areas and some of the smalti had loosened. The restorers need to incorporate a lightweight backing, repair, regrout and clean the surface and provide an aluminium frame for on-site fixing.

The mosaic is a fine example of Whitefriars work, of a quality normally found in an ecclesiastic setting. It is unusual in being glass rather than ceramic and is historically important, as well as being unique in depicting glassmaking in Europe through the centuries. It is dedicated to the memory of Professor W E S Turner's first wife, Mary Isobel Turner.

In order to pay for the restoration, the Department is seeking contributions from as many sources as possible. All donations will be acknowledged when the mosaic is finally in place. Cheques, made payable to 'University of Sheffield', should be sent to Professor C M Sellars, Department of Engineering Materials, University of Sheffield, PO Box 600, Sir Robert Hadfield Building, Mappin St, Sheffield S1 4DU, UK.