Barrier walls: a new approach

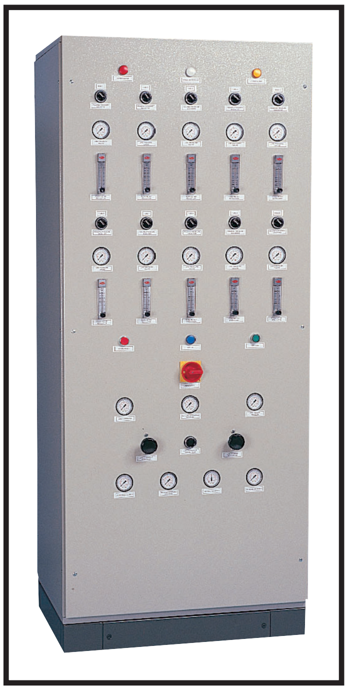
Stuart Hakes* advocates the use of water-cooled bubblers for container furnaces.

In the past 10-15 years there has been a significant move in the glass container industry to adopt refractory barrier walls in the furnace area, often in conjunction with deep refiners. This approach states that the physical barrier of the wall forces the natural convection currents at the spring zone of the melter closer to the surface, thereby aiding refining and final melting prior to entering the refining area before the throat. This may well be true, but the problem arises when the barrier wall starts to erode during the course of the campaign. No matter what construction techniques are used - such as two rows of blocks with offset joints, special cooling from below in the construction of the floor to slow down wear, protective steps on either or both sides of the barrier wall - at the end of the campaign there is severe wear on the wall with large gaps at the vertical joints, or often no wall at all - certainly not an effective barrier. There is no noticeable deterioration in glass quality at any stage of the campaign.

As a natural progression of longer furnace lives the thermal efficiency decreases with age, but in my experience there is no discernible difference in the thermal efficiency reduction, with or without a wall - and yet the glass quality is still able to be maintained at normal commercial levels. This must question the effectiveness of the barrier walls. These walls are expensive, even at initial plant concept, requiring more complex steel and additional refractory. If the wall is constructed as a modification to an existing furnace, then the cost of modification is considerable. Even with the current generation of inspection machines we cannot guarantee to remove all stones.

The industry has used physical barriers for many years. The bubbler system, which is perhaps one of its earliest forms, is well proven. However it does have the disadvantage that ceramic, platinum, inconel or Kanthal bubblers have to be located close to the bottom of container furnaces as they lack mechanical strength to operate deeper in the glass. They can cause serious erosion of the bottom, even if the rate of bubble evolution is carefully controlled. For this reason it is strongly recommended that when using these bubblers, a special resistant layer such as 41% zirconia of suitable thickness (typically 250mm) is used for the bubbler blocks and surrounding areas. This increases the cost a little but costs nothing like a barrier wall; however the possible reduction in furnace life due to floor erosion is a serious drawback to this use.

Using electrodes in the hot spot is perhaps the most efficient barrier wall, but is generally unrecognised as such. It also adds additional heat where it is needed in the body of the glass, and the forward and reverse spring currents dramatically improve melting and refining, resulting in additional tonnes of glass. However many people are nervous of vertical electrodes based upon outdated fears of possible electrode holder failure and subsequent loss of glass. Contaminant-free molybdenum electrodes and modern electrode holders with electrode breakage detectors can lay these fears to rest. However, the capital cost of the transformers etc is not small, and if additional pull is not required then it is difficult to justify this kind of barrier.



▲ *FIC's bubbler control panel has three air sources.*

A third method advocated by FIC is the use of water cooled bubblers of the type used on float furnaces. When bubbling in float glass it is necessary to have the bubbler tip at the neutral point in the glass depth, which is approximately two thirds up from the bottom to stop parasitic seed from forming when two bubbles meet. This works because if the bubblers are in the down position close to the floor, each bubble expands when it rises and reaches the hotter glass. So when one bubble is consumed by another, parasitic seed is formed. As this is quite close to the glass surface it is entrained in the main mass flow and does not have time to refine in the refining area. Water cooled bubblers for float furnaces are used in the down position as this reduces the colour change time. When the new tint is established the water cooled bubblers are pushed back to the neutral point position. Water-cooled bubblers are easily inserted or retracted into the melt as they incorporate special features to facilitate this movement.

If container furnace operators use these water cooled bubblers well above the furnace floor, they would have the advantage of bubbling without any risk of wear on the floor, and would also create a physical barrier when the cold glass adheres to the water cooled bubblers. Although this would extract some heat, this is advantageous in container furnaces as we are using large quantities of gas in the distributor and refiner simply to lose heat. Any small amount of heat loss after the melter in the refining area of the main melter is advantageous. FIC has experience with these water cooled bubblers, which have one small weld where the air tube protracts above the water cooled sleeve. This is so that, if the water cooling is lost, the air is still cooling the welds and therefore minimising the risk.

The FIC-supplied bubbler control panel incorporates three sources of air supply to the bubbler system. During normal operation, compressed air at 6-10 bar (minimum 4 bar required) is fed directly from the factory compressors (normally instrument air) as the primary feed. A separate compressed air feed from alternative compressors (normally main factory air) is used as a back-up. A third line connected to a cylinder containing a large volume of compressed air is recommended for emergencies. A regulator is supplied for each line and these are set at different pressures so that an air supply is always available, regardless of the situation in the plant. The control panel incorporates all the required filters and drains. The system includes a special air circuit that maintains a holding pressure; this enables the bubblers to be stopped for extended periods without the risk of glass entering the bubbler nozzle, and can be restarted at will.

FIC can supply variable frequency bubble systems if necessary, but this increases the price of the bubbler system without offering any associated increased financial payback. FIC has experience in bubbling in flat glass, fibre and hollowware for both soda-lime and borosilicate glasses.

* *Stuart Hakes, managing director, FIC (UK), Penzance, Cornwall, UK. Tel: +44 1736 366962. Fax: +44 1736 351198. Email: general@fic-uk.com; Website: www.fic-uk.com*