

Benefit from viewing the dance of the batch

Toledo Engineering's Christopher J Hoyle and Douglas H Davis explain why batch charging is key to quality and efficiency.

Computer models of glass furnaces have yielded important information, providing an excellent overview of glass flows. Models are especially useful for describing the action in places that can never be seen, including the waist area of a float tank, transitioning from the refiner to the working end, as shown in figure 1.

At Teco, computer models have enough value for the organisation to employ three dozen large PCs running simulations for clients. These

allow various 'what if' scenarios to be run, without putting any brick or steel in place.

However, computer models must make significant simplifications to describe the batch on the molten glass. The furnace corresponding to this model has a batch distribution as shown in figure 2, superimposed on the model.

The difference between this simplified batch representation of the model and the more complex actual pattern is important. That pattern describes the dynamics of the melting process and this can affect the bottom line.

Two heat sources operate in Teco glass melting furnaces; fossil fuel fires above and molten glass beneath, the rearward flow efficiently delivering energy to the surface. Simply, batch is slipped between these two

sources. However, there are different ways to deliver the batch and some are better than others.

VIEWING CIRCULATION PATTERNS

Therefore, to describe the batch pattern, it is necessary to look in the furnace. Modern water-cooled periscopes with video cameras are excellent tools. However, an often overlooked tool is the time lapse recorder. Viewing the recorded batch area in highly speeded-up mode allows users to see the circulation patterns of the batch, ie the 'dance of the batch', as it responds to the underlying glass, the push of the chargers and differences in energy flux.

This 'dance of the batch' should include:

- Batch needs to be pushed down tank.
- Maximum batch surface area.
- Melting residuals ending at the rear of the furnace, not the front. For this, it is necessary to have loose batch piles that can respond to the glass current and open space not blocked by batch moving down tank, allowing residuals to be returned by the glass current toward the chargers. Residuals need to go far enough back to become incorporated with new batch, generating more time for homogenisation.

An example of a suitable pattern is an end port furnace with a single sidewall charger (see figure 3). The charger pushes batch across the tank, sufficiently down tank to keep batch from being trapped in the rear of the furnace. With two chargers, the second can help steer. This wheel pattern includes the required steps of the dance, the rotation direction being unimportant.

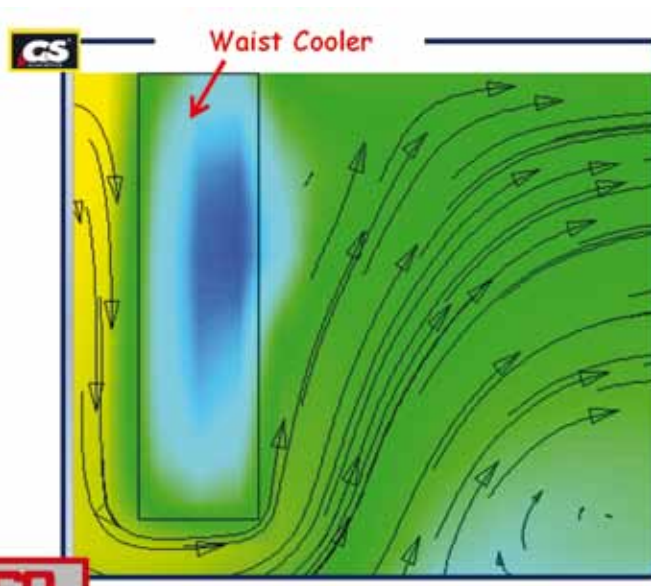


Figure 1: Models are especially useful for describing the action in places that can never be seen, including the waist area of a float tank.

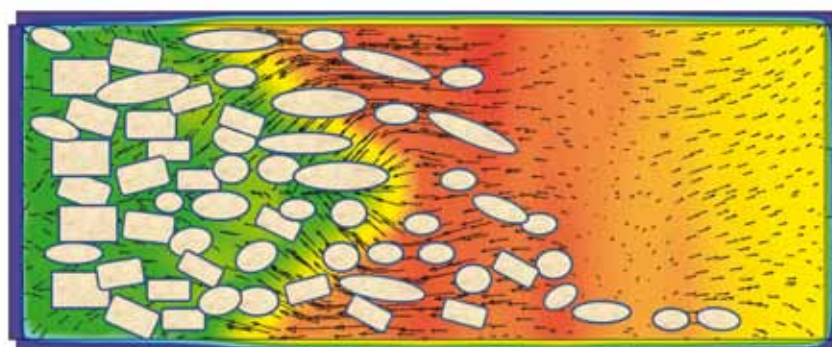


Figure 2: Batch distribution, superimposed on a computer model.

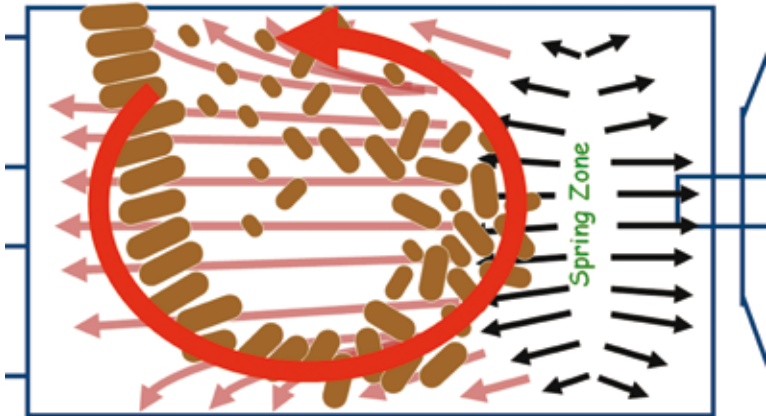


Figure 3: Charging pattern from balance of forces.

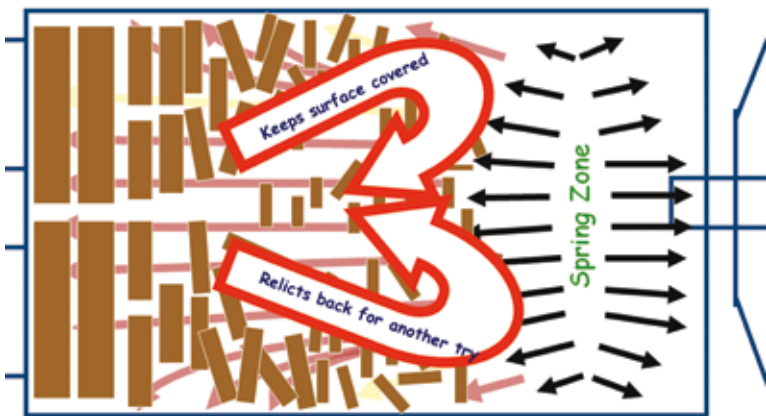


Figure 4: Heart-shaped pattern on a side port furnace with rear table charger.

A heart-shaped pattern on a side port furnace with rear table charger fits Teco's requirements for the dance (see figure 4). Splitting the batch at the end and returning down both sides (mushroom pattern) is also satisfactory.

A serious omission from this presentation is the thermal profiling that must be imposed on the mass of glass so that the spring zone and the overall convective flows are indeed present. Fossil-fuel fires and any electric boost or bubbling have to be carefully structured and maintained. However, the goal here is to encourage time lapse recording and paying attention to the dance of the batch.

PERISCOPE FOOTAGE

In Teco's Hotbels 2010 conference presentation, films from real furnaces were reviewed; both good and bad, in time lapse mode. Periscope footage from an end-port furnace with a single sidewall charger showed a good recirculating wheel pattern, with the residuals returned to the charger area by the rearward convective flow (see figure 5).

Further footage was from an

older side port furnace, with a shadow wall shielding a refiner (figure 6). This tank provided no recirculation of batch, ie batch simply pushed down tank until it melts. Of course, this was not a charging problem alone but also a thermal profile problem which did not provide significant rearward current.

Next, a side port tank charged from rear wall table chargers was observed (figure 7). Here, it was possible to see the strong recirculation that has been so important to the stringent quality required by float glass. Partially melted residuals move completely back to the charger to get a second chance at melting out and homogenising. Higher tonnage modern side port tanks have wider batch patterns and less open space for batch return. Many have gone to the horseshoe pattern, tucking the returned residuals into the centre.

To summarise, glassmakers are urged to use periscope more fully, while also using a time lapse recorder to see the 'dance of the batch', which cannot be understood from casually watching the monitor in the control

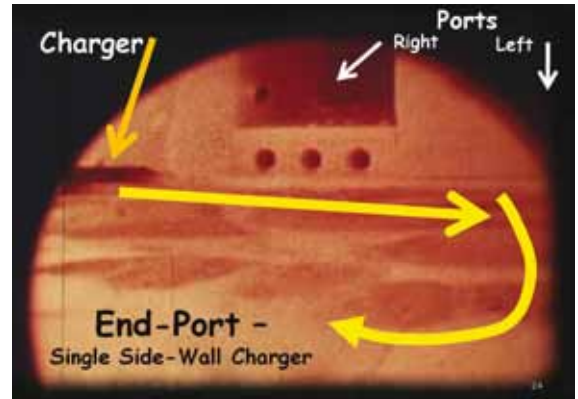


Figure 5: Periscope footage from an end-port furnace with a single sidewall charger.



Figure 6: Footage from an older side port furnace, with a shadow wall shielding a refiner.

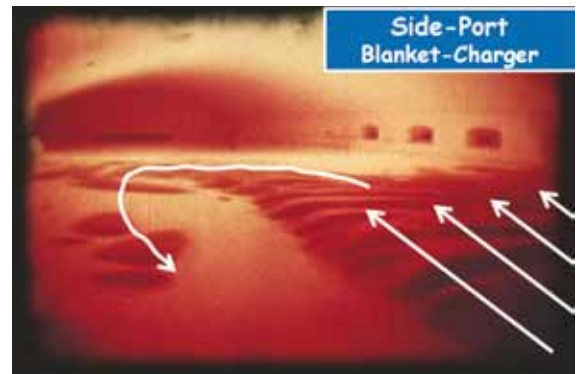


Figure 7: Side port tank charged from rear wall table chargers.

room. Most importantly, ensure batch circulation is achieved, thereby improving energy efficiency and glass quality.

The critical question is: Do you want residuals from the melting in front of the blanket, waiting to sneak into your product, or returning for a second chance at complete melting? ■

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