Increased electrical power sees HORN boosting sustainable glass production

Coupled with the need to cut CO2 emissions, rising fossil fuel costs in many parts of the world is pressuring industries to explore and leverage alternative energy sources. Here glass is no exception, which is why HORN continues as a supplier to create fitting solutions that ensure glass producers can better tackle such challenges.

Oxy-superhybrid furnace powered 80% by electricity.

All electric furnace with top electrodes for 200tpd.

In the race towards net zero, a leading notion -perhaps the best solution out there- is that of wholly substituting fossil energy sources with green alternatives. Here biogas or green methane can be used as a more direct replacement to natural gas. Hydrogen, at the centre of much talk, is another option.

However, low efficiency as regards electric energy input represents a problem for most of these substitute solutions. But wouldn't it make more sense to simply bypass the artificial fuel and incorporate more electric power directly to the glass melting process instead?

On that score, HORN's conceptual approach can be subdivided into three groups:

- Hybrid technology: Increase the electric power input in a classic setup (end or side-fired) up to 40 percent or even 80 percent;
- The All-Electric furnace: Use the long-existing technology of all-electric melting and update it to match the requirements of glass producers outside high quality and specialty glass;
- Electric forehearths: Apply electric heating - not only to the melting process but to glass conditioning and distributing too.

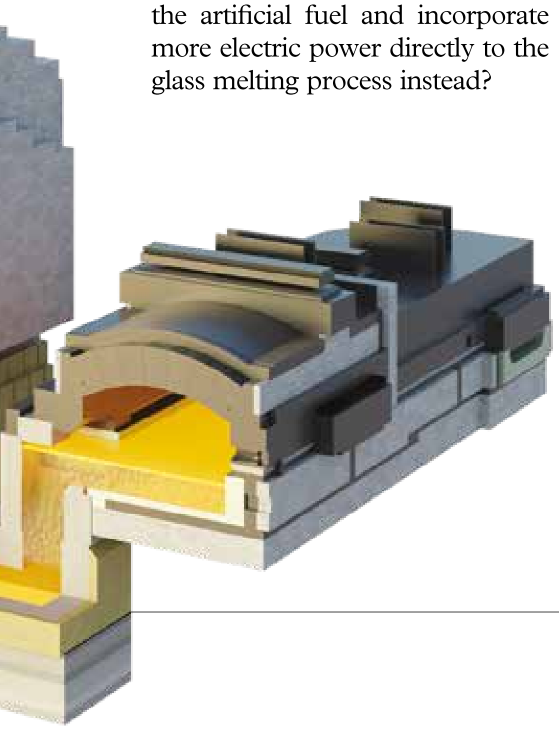
HYBRID FURNACES

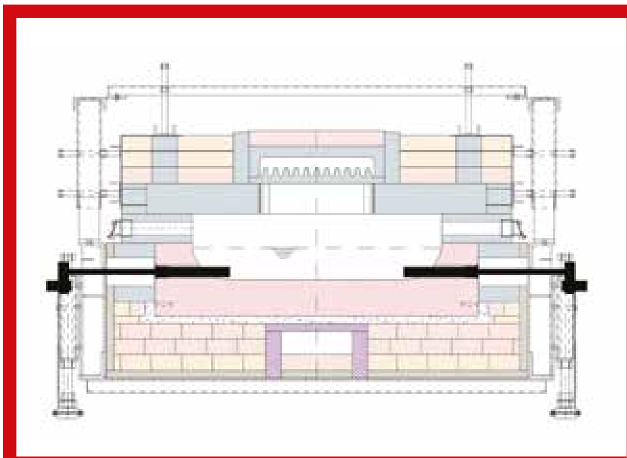
HORN divides furnaces into three basic categories depending upon their electric share:

- Boosted (Classic): with up to 20 percent, representing the upper limit of what is done;
- Hybrid: ranging from 20 to 40 percent for end-fired regenerative furnaces and up to 50 percent for oxy fuel furnaces;
- Superhybrid: from over 50 percent to 80 percent of electric share for oxy fuel furnaces.

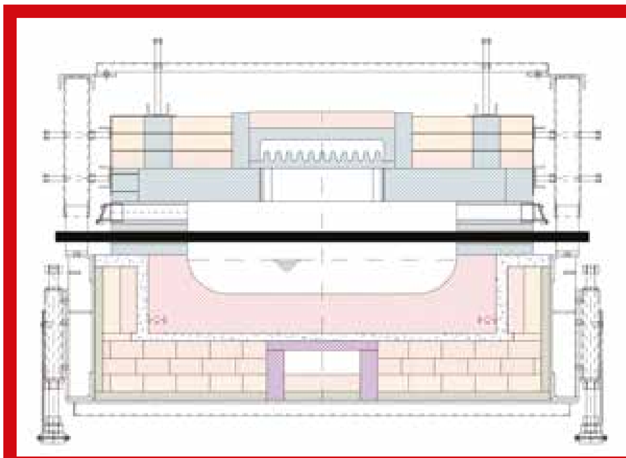
The two hybrid categories bring some challenges to furnace design and conceptualisation. Temperatures for different parts of the furnace will differ greatly from what is experienced in the more classic setup. Lower temperatures in the superstructure are the result of reduced fossil combustion - requiring an adapted refractory concept (lime free silica <-> standard silica). The high electric input on the other side will increase glass temperature in the distributor. Combined with a steep increase of convection due to the influence of a high number of electrodes, corrosion especially of the tank bottom is expected to be much higher.

A main goal of the hybrid furnaces is to maintain the well-known horizontal melting process principle of classic fossil furnaces. For an oxy fuel furnace the distribution of a multitude of burners along the glass flow allows for excellent tuning of the temperature profile to match that of a classic furnace. An added shadow wall dividing the superstructure into two parts is only deemed necessary when flexibility is very high. Depending on size, quality and flexibility, other additional features could be





Forehearth with electrode heating and indirect cooling.



Forehearth with SiC element heating and indirect cooling.

a refining shelf, a deeper refining part and the possibility of flue gas recirculation to increase the burner port velocity and secure a proper flame formation for hybrid end fired furnaces.

THE ALL-ELECTRIC FURNACE

Electric melting is hardly ‘new’. Nowadays usage of the term usually refers to high quality or specialty glass, given that certain challenges hamper the production of, say, container glass. The culprits are a limited pull rate maximum (< 200 to/d), restrictions concerning pull change flexibility, cullet fraction and a shorter lifetime. Here HORN is hard at work tackling the disadvantages with a view to overcoming them or at least softening their impact.

To best meet the needs of glass producers, upscaling of an all electric furnace is crucial. This is because a pull rate of 200 to/d is currently around the lower end of the scale for the production of container glass (not to speak of flat glass). To achieve it, HORN is shifting from the round shape (octagonal or dodecagonal) to a rectangular shape for bigger, all-electric furnaces. For a round furnace the distance between top electrodes would be much higher in an upscaled version (80 percent increase by going from 60 to/d to 200 to/d). The direct result would be a high instability in the melting process. In the rectangular setup, the distance would only be 10 percent higher and the process still controllable. The rectangular furnace is a proven furnace shape. This furnace type has been successfully installed and operated for decades by HORN’s daughter company JSJ Jodeit.

In today’s most recent all-electric furnaces, flexibility regarding cullet fraction changes and pull rate is very reduced. This can mostly be attributed to the stability of the insulating batch layer on top. Changes to this layer by using more or less batch can lead to insufficient thermal exchange between glass and melt or the creation of holes in the layer as well as, subsequently, an elevated thermal loss. By using a higher furnace depth the glass residence time is increased. If changes to the cullet fraction/pull rate now require a reduction in electric power then longer residence time helps to secure glass quality with lower electric input as well (and therefore lower temperature level). Being able to operate the furnace with a lower temperature level will also help to increase the lifetime.

ELECTRIC FOREHEARTHS

With most energy consumed by the melting process, glass conditioning and distribution is also an area where a switch to electric heating can save fossil fuel (and potentially costs). Here electric heating options include both a direct and an indirect possibility. For direct heating, Molybdenum electrodes are installed in the glass bath. This may be used for coloured glasses but it can lead to defects with flint glass (sulphate fining). Another disadvantage is the use of indirect cooling only - which can limit flexibility.

For indirect heating, SiC electrodes are placed above the glass melt. Glass colour is no factor here, but the restriction of indirect cooling applies as well.

High investment costs for these electrical heating systems (and their restrictions) must be weighed against the long-term potential of energy savings (e.g. from 70 percent up to 85 percent for 120 tpd). ■