AFGM ASEAN FEDERATION OF GLASS MANUFACTURERS
glass WORLDWIDE OFFICIAL JOURNAL

Making the switch to all-electric melting

Stephen Sherlock from Fives shares recent developments that are helping to improve the glass industry's understanding and adoption of all-electric melting as a means to achieving low CO_2 emissions at plant level.

CO_2 emissions are the primary driver of global climate change. It is widely recognised that to avoid the worst impacts of climate change, the world needs to urgently reduce emissions. How this responsibility is shared between regions, countries and individuals has been an endless point of contention in international discussions.

In the glass industry, the major environmental impact is caused by atmospheric emissions from primary melting activities in fossil fuel fired furnaces. Putting aside present-day economics, the need to reduce emissions and move towards CO_2-neutral production will not only be driven by legislation, but also by the consumer demand for greener, more sustainable products. Therefore, present-day fuel costs may become irrelevant if glass producers fail to meet the environmental expectations of their customers.

Now that many countries are progressively decarbonising their electricity production, it is important that glass producers are ready, not only to participate in, but also to promote the industry's decarbonisation journey for glass packaging. Fives, as an international engineering group, considers its mission in offering technologies that allow green glass production at point of use.

All-electric melting[1]

In this article, we are interested in 'direct' electrical heating by the Joule effect – resistive heating. However, there are other possible applications of electric energy for glass melting which are not considered in this article such as:

- Indirect use of electricity to produce hydrogen and oxygen
- Induction, radiative and microwaves technologies
- Carbon capture or H_2 combustion

Electric melting is highly efficient and extensively applied to most types of glass at scale where composition, fuel-economics and/or other local factors favour it.

The Prium E-Melt, a fully electric, cold top vertical melter (CTVM) from Fives, presents, in principle, the most efficient solution to low CO_2 emissions at plant level (see Figure 1).

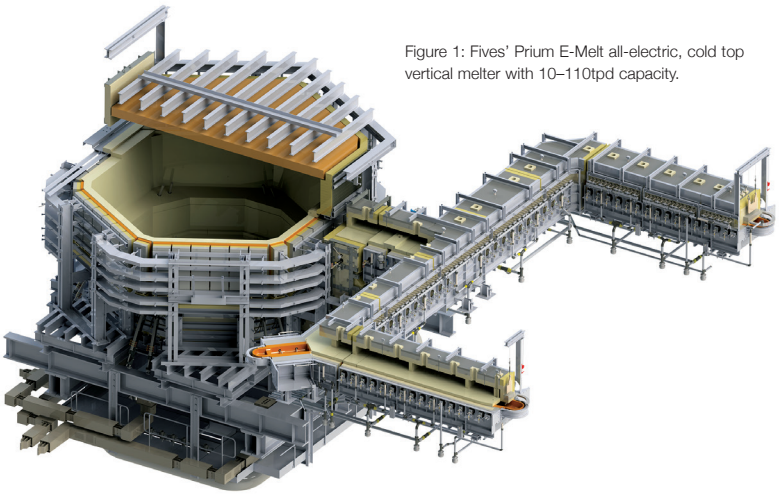

Figure 1: Fives' Prium E-Melt all-electric, cold top vertical melter with 10–110tpd capacity.

Growing confidence for change

The glass industry is conservative in its approach to change. The development of fuel-fired furnaces in the container sector has been a long evolutionary process, with a conservative mindset that can hinder a change to alternative heating technologies and progress toward true decarbonisation of the glass melting process.

The switch into all-electric furnaces is a step change for the container glass industry. However, the risk associated is not as large as portrayed because the technology is proven, albeit on a smaller scale. Today, size limitations are determined by production requirements, not the technology itself, which has now changed.

Recently, two European container glass producers – Verallia and Pochet Group – signed strategic partnership agreements with Fives to reduce carbon emissions and adopt all-electric melting at their plants. These new investments are part of the glassmakers' strategy to ▸

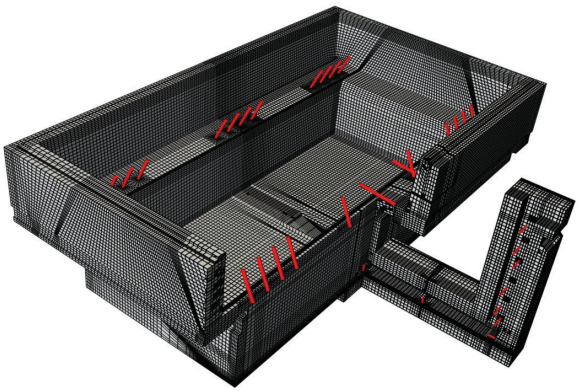

Figure 2: Prium E-Melt cold top vertical melter with a rectangular layout and 150–200tpd capacity.

Figure 3: Cold top charger over batch blanket in a cold top vertical melter.

AFGM ASEAN FEDERATION OF GLASS MANUFACTURERS

This article is based on a paper presented at the 44th ASEAN Glass Conference in Pattaya, Thailand, in November 2022 **www.aseanglass.org**

Glass Worldwide is the official journal of AFGM

ASEAN FEDERATION OF GLASS MANUFACTURERS
glass WORLDWIDE OFFICIAL JOURNAL

Figure 4: Prium Eco-Flex furnace with H.R.A. of 250–500tpd capacity.

modernise production capabilities, with a view of sustainable growth while delivering 50% reduction in CO_2 emissions by 2030.

These projects include the design and supply of Prium E-Melt cold-top vertical melters (see Figure 2), designed to significantly reduce CO_2 emissions at the plant level. Formulated by Fives' significant electric melting expertise, the largest of these melters for Verallia will have the capacity to produce up to 200 metric tonnes of glass per day.

Hybrid furnaces[2]

All-electric furnaces do have limitations imposed by their dependence on the batch layer (blanket) across the melt surface (see Figure 3). Maintaining a stable blanket is critical in achieving the correct thermal profile in the tank, thereby producing a proper glass quality.

Container glassmakers often require the production of a variety of coloured and reduced compositions in the same furnace. The industry is also characterised by use of high and varying cullet levels. The differences in melting characteristics between flint and coloured compositions, and adapting to high cullet content, can create some challenges when designing a cold top furnace which will accommodate more than one type of glass. Design compromises are possible although these will inevitability further restrict operational flexibility.

This last factor has on occasions resulted in the use of a technological variance on cold-top melting; warm-top vertical melting uses a small gas heat input above the batch to extend the range of sustainable melt rate thereby increasing load flexibility.

Hybrid furnaces (see Figure 4) overcome these restrictions and provide flexibility in terms of pull, cullet content and glass colour. Hybrid furnaces for reducing CO_2 emissions aim to reduce combustion. This has consequences for the batch melting process and for the temperatures of melt and furnace superstructure. The design of the upper furnace and the layout of the combustion system must be adapted to provide a design that can operate with high levels of electrical energy input. Fives has developed the Prium Eco-Flex furnace with the patented Heat Recovery Area (H.R.A.) that can be tailored to customers' needs.

Stephen Sherlock presenting at the 44th ASEAN Glass Conference in Pattaya, Thailand in November 2022.

Figure 5: BH-F E-Forehearth with conditioning section boost electrodes.

Glass conditioning – forehearths

If the target is to completely eliminate combustion emissions, then we must also think about working ends and forehearths. Electrical direct (immersed electrodes) and indirect (radiant) heating systems (see Figure 5) have been successfully applied to most glass types for many years. In addition to zero CO_2 emissions, excellent glass quality and thermal homogeneity, full electric systems offer much lower energy consumption than equivalent gas-heated working ends and forehearths and are simple to operate with minimum set-up and low maintenance.

Conclusion

Electric melting is considered to be the best technology available to make your investment fit for the future, ready to meet environmental, legislative and consumer demands.

The technology must be implemented with a full understanding of plant layout, product mix between lines, output ranges and compositional changes to allow proper management of the electric melting process. Then with proper monitoring, control and maintenance, the furnaces will run with a stability and energy efficiency that surpasses any type of fuel-fired alternative.

Today, Fives pushes ahead to ensure that tomorrow's furnaces not only perform to expectations on energy efficiency, life and glass quality, but that projects can be implemented with minimal risks and maximum returns. Indeed, the entire glass industry, producers and providers, must work together to set the strategies which will ensure that glass remains the preferred choice of packaging material for future generations. ●

Prium is a registered trademark of Fives Stein Ltd

1 W. Kuhn, A. Reynolds ICG Boston 2019.
2 W. Kuhn. 'A hybrid approach to the future' G.I 2022

About the author:
Stephen Sherlock is Sales Director at Fives

Further information:
Fives Stein Ltd., Oxfordshire, UK
tel: +44 1235 517231
email: stephen.sherlock@fivesgroup.com
web: www.fivesgroup.com