

Monitoring methods for new melting technologies

Fred Aker outlines challenges associated with options for replacing traditional furnace operations with low-carbon melting campaigns and explains how PaneraTech is offering support for glassmakers faced with a whole new batch of unknowns.

'Sustainable World Solutions' was the theme of the AFGM's [ASEAN Federation of Glass Manufacturers] 44th ASEAN Glass Conference in 2022. There were numerous presentations dealing with decarbonising the glass industry.

Regardless of which option manufacturers choose, refractory corrosion will be different and an unknown during initial campaigns. These new melting technologies include all-electric, highly boosted hybrid melters as well as the use of hydrogen. Not new, but increasing in importance, is the increased use of post-consumer recycled content, or in simple terms: external cullet. Poorly processed external cullet can introduce impurities into the furnace.

All-electric

Commodity glass producers changing from regenerative to electric furnaces will face several challenges. First, they need to learn entirely new batching and furnace operations during their first campaign. The second challenge will be foam when trying to incorporate high external cullet content. The third challenge will be shorter furnace campaigns compared to traditional fossil fuel fired furnaces.

Initial wear will occur further down the sidewalls.

Companies that are used to taking physical measurements with a hook at the metal line will no longer be able to do so while operating. This is due to the corrosion occurring further down the wall as well as the safety aspects of dealing with an energised glass bath.

Where extensive bottom electrodes are used, there will be higher corrosion in the bottom. Due to safety concerns, these electrodes will largely be inside of 'boost cages' which will require the furnace to be de-energised before doing routine visual checks.

These furnaces will also require new maintenance skills, such as pushing electrodes and changing electrode holders during the campaign.

PaneraTech is already supporting many all-electric furnaces (borosilicate, opal, LCD) and we can apply current practices. This includes normal SmartMelter portable equipment for furnaces that are grounded. Depending on plant safety regulations, measurements may be possible while the furnace is energised. Then boost would be turned off when checking areas adjacent to electrodes. We also have highly insulated equipment that has been safely used on LCD furnaces while under power. SmartMelter portable equipment is already used to get full coverage.

For constant refractory thickness monitoring of high wear areas, inaccessible areas in a boost cage or to gauge general corrosion, Polaris will be the answer. Polaris is already

Is it safe to touch the furnace while in operation?

Will there be safety cages to prevent personnel from going under the furnace?

Physical measurements (hooks) only practical when boost off

Pushing Electrodes / Changing Holders



Fred Aker presenting at the ASEAN Glass Conference in Thailand last year.

being used on conventional furnaces to measure high wear areas. For an annual monitoring fee, we can lease and install permanent sensors that monitor refractory thickness 24 hours a day. When the remaining refractory thickness fall below pre-defined thresholds, Polaris sends out alerts. These can be in our XSight platform, in the form of emails or

however the customer defines.

Polaris sensors are robust and maintenance-free in areas up to 1,000°C. They can be placed anywhere there is refractory. The sensors can be installed during construction or on the fly. They can also be moved during the campaign or replaced on top of overcoats. ▶



A technical session at 44th ASEAN Glass Conference.

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Polaris sensor on a throat.

Hydrogen melting

Hydrogen offers the advantage that much of the existing furnace infrastructure can be modified and reused. Melting processes remain very similar. Challenges related to hydrogen include the fact that it is the smallest molecule [of all elements] and that leaks can occur easily. The other challenge is that with 100% H₂, glassmakers will be monitoring an invisible flame. Combustion expert Neil Simpson said at the 2022 Furnace Solutions [the Society of Glass Technology's Furnace Solutions meeting held 8–9 June 2022] that "In regard to hydrogen combustion it could be beneficial if you cannot see the flames. In many air fuel applications you have to wait for the reversal to be able to see the batch pattern or the thermal impact of combustion on the process. In hydrogen firing with invisible flames you can see the batch and thermal data all of the time."

I would add that it can also be a bad thing with misaligned burners impinging the superstructure.

Up until now, SmartMelter has primarily been used below the glass line; however, PaneraTech is developing Digital Endoscopy to monitor superstructures. Hydrogen may lead to new refractory selections and different wear patterns. Digital Endoscopy employs laser scanning from outside multiple peepholes together with external reference points to provide depth. By comparing multiple scans, it will be possible to quantify superstructure changes over time. This can include erosion of the crown or leaning superstructure walls. At least initially, Digital Endoscopy will be limited to our Digital Furnace Monitoring clients using PaneraTech for all of their refractory auditing needs (visual, thermal, traditional endoscopy, and SmartMelter radar).

Hybrid melting

If you speak with three people on hybrid melting, you will come away with six different definitions. Definitions include:

- High boost with natural gas. Varying opinions on what high boost is range from 20-80%.
- Mixing natural gas and hydrogen with and without boost.
- The above combinations with bio-fuels.
- All of the above alternatives in oxy-fuel variations.

For the sake of the AFGM conference, I considered hybrid melting to be natural gas with high levels of boost. In this case, all of the PaneraTech technologies discussed are relevant. Portable SmartMelter inspections for wide coverage. Polaris online monitoring for high wear or difficult/dangerous areas to access. Traditional and possibly digital endoscopy for the superstructure.

To tie everything together, we have developed our XSight Refractory Monitoring Platform. This is the same web-based 3D interactive platform that all of our radar customers receive their SmartMelter reports in. Our Digital Furnace Monitoring and platform clients receive a full license which allows them to store all refractory observations and measurements. These can be photos from daily shift walks, thermal, radar or endoscope images. Also, all refractory maintenance records are stored in XSight. The platform can be multi-furnace, multi-plant, as well as multi-language. It also includes a corporate user rights structure and can be stored in the client's



Fred Aker (right) with Somporn Temudomsomboon, Chairman of the Organising Committee of the 44th ASEAN Glass Conference and CEO of Kabinburi Glass Co., Ltd.

private cloud.

In addition, live data can be incorporated as well. This live data can be from a SCADA system, display the status of Key Performance Indicators as well as live Polaris thickness measurements.

Digital Furnace Monitoring

Digital Furnace Monitoring is our programme using the best tools available to manage refractory maintenance to extend furnace campaigns safely. DFM is not a predefined off-the-shelf product or service. We define DFM together with our clients to enable them to meet their furnace campaign goals (e.g. younger furnaces have different monitoring needs compared to one which has operated past its designed lifetime); then we jointly calculate the client's return on investment.

I want to express my gratitude to the AFGM for the opportunity to present this topic as well as for the incredible programme and organisation. ●

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