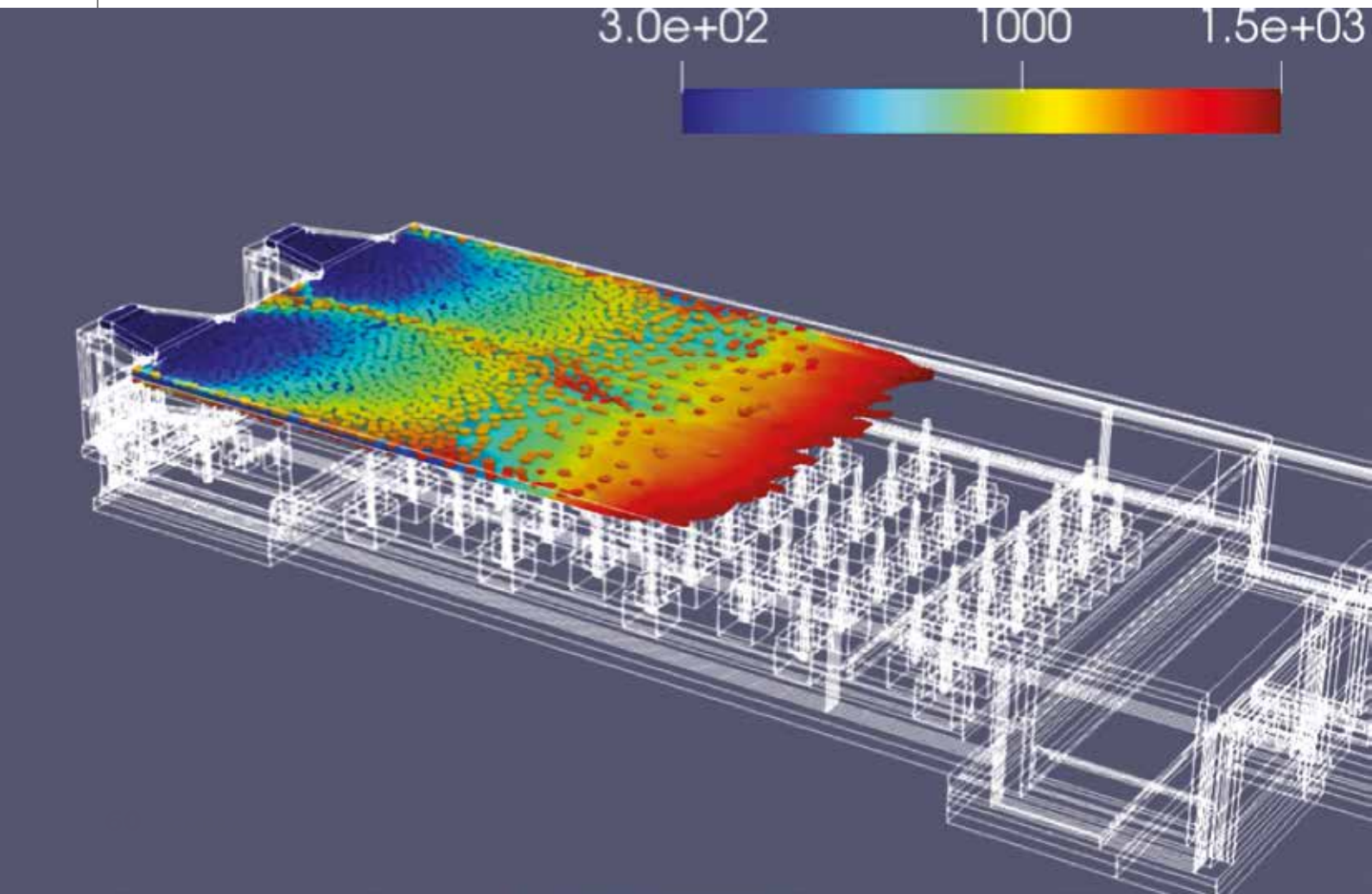
Hybrid furnaces: a BDF INDUSTRIES perspective

What makes BDF different from the other suppliers is the way it's been able to merge the smart engineering needed to face glass melting and conditioning with the industrial soul yielded by over a century of mechanic workshops. Today the glass melting market is divided into two main demands, namely that of pursuing the best available techniques respecting actual arrangement, unconnected to emission restriction, and that of battling now against time to manage the zero emission challenge by 2050 whilst working towards that goal.

BDF is following both paths - all with a view to claiming and retaining its position as one of today's top suppliers and even increasing it going forward. Here the company's strategy is to be focused and keen on Industry 4.0 as a tool for both improving performance and doing diagnostics. Indeed having diagnostic clout in these days of innovation can prove a game-winning factor in the choice among different solutions and technologies. The team at BDF is nonetheless mindful that this mission cannot suffice on its own as a strategy for CO2 reduction and that other technical solutions within our portfolio will also need to be presented.

BDF'S TAKE ON THE HYBRID FURNACE CONCEPT

In pre-pandemic times the world's container glass furnaces, considered from 80TPD to 550TPD, numbered 1163 (Glass Global 2019), categorised as follows:
18 (1,5 percent) fully-electric



Founded in 1906, BDF INDUSTRIES has focused throughout its long history upon covering the entire hot end of container glass plants. The company's first forehearth and furnace design dates back to 1953 – following which automation became a reality in the early 80s.

31 (2,6 percent) All Oxygen Melting AOM or oxyfuel
59 (5 percent) recuperative furnaces
196 (16,8 percent) regenerative cross-fired furnaces
845 (72,7 percent) regenerative end-fired furnaces
14 (1,2 percent) furnaces made with different technology than above

This data underscores the industry's need to leave the furnaces of the past behind -once for all- and to usher in an entirely new era in glass melting. Taking a small towards the future some groups are already switching to Oxyfuel or to fully-electric. However, these remain with solutions that are already proven in the market.

The CO2 reduction challenge in Europe has set the goal of zero Emissions to be achieved within 2050 - with an intermediate step in 2035. Though it has already been articulated, it's important to reiterate that this is 'only 2-3 furnaces away from now'. A common feeling about this ambitious goal is to consider achieving Power Grid Market capacity to only supply green, zero-CO2 electricity to the grid - at an affordable price and on the same date. This leads to the idea that the All-Electric Melting (AEM) furnace type can be the ideal solution. The pros of the AEM over the other possibilities are as follows:

- AEM is a proven solution on the market
- AEM is the most efficient Furnace type in terms of energy consumption
- By the above assumptions the CO2 goal remains easily achievable

TIRELESS ATTENTION TO COSTS

All notwithstanding, the entire scenario leaves space for certain questions concerning the OPEX burden of this project type, scalability to high pull furnaces and the possibility of producing reduced glass articles.

Cutting out an entire slice of the market hardly represents an uncomplicated way forward as a reduction in glass would only open a soft spot for the competition with

other food and beverage packaging industries like plastic, aluminium or paper. Another factor is that electricity costs could become a CAPEX and OPEX limitation, obliging the glass industry to forsake Europe. That would not come as good news, considering how related the industry is to transportation. Instead a wise approach to such a mammoth challenge is preferable, and here reaching this shared target one step at a time is where BDF sets its sights. The hybrid furnace offers precisely that step-by-step solution - not only in regard to the main question of CO2 reduction but also concerning the pull issue of scalability, flexibility around OPEX management and the added possibility of reduced glass manufacture.

HYBRID TO THE CORE

Having already been presented to various container glass producers, the BDF concept has been jointly developed with Glass Service in the Czech Republic and FIC has been modelled and designed for more than 15.000 hours since the first proposal was made back in 2017. Totally unassociated from the CO2 reduction strategy, BDF considered 2017 the Hybrid solution as a valid innovative proposal for a customer before R&D progressively took the lead in the interest of the market and consequently in company strategy. Now the company is practically overwhelmed by 'hybrid solutions' - also in daily advertising around cars, house design, tools, etc. Here's why following the project decisively has been a natural behaviour ever since. Indeed the hybrid furnace is deemed a good compromise step that can lead the way to both total electrification of melting - all the while remaining open to hydrogen combustion development.

KEEPING INDUSTRY CONVERSATIONS ROLLING

The active discussion BDF has had both with glass producers and other players within the industry over these years has helped the company to focus independently upon every small challenge while scouting for solutions that can adapt to the general consensus. BDF has also modelled and designed solutions that are based upon air-gas combustion, even if that concept resulted in less flexibility in fuel-boosting switching owing to air preheating.

OPEX cost flexibility comes from the possibility of oxyfuel combustion to use different ratios of fuel and electricity as the main melting factor for the glass. The outcome of the BDF experience is that the higher the goal of flexibility the greater the difficulties of design. A good compromise could be at about 40:60/60:40. Here the main technical challenge is crown temperature movement as it switches between different melting configurations. After its discussions with refractory manufacturers BDF remains confident about research

and choice modelled around the material over these years. This flexibility is especially crucial for the company's market because it affords glass manufacturers the possibility to control production costs while remaining competitive at sales - all with a shared and distributed benefit in terms of money-saving and sustainability.

The high pull is not a real issue for this type of furnace and it is also testable from real applications outside the container glass market. One of the fears of furnace operators is to deal with this heavy bottom boosting and still have a high percentage of cullet - with consequent iron contamination. BDF has a dedicated answer for this concerning the design but also the choice of material on this part of the furnace. Different manufacturers have brought issues like foaming and redox control to the company, prompting it to make some modest modifications to its design and models. In this way all the collective intelligence has been integrated into the concept - resulting in a very reliable and production-driven proposal.

Improvements to the electrode number, which can reach more than eighty depending upon furnace size, glass quality, and capacity, is a further challenge. Here too BDF has a strategy to reduce to the lowest both wear and any consequent maintenance load. Based upon the specific customer application, the company can tweak the hybrid concept in terms of geometry, electrodes and power distribution, as well as chemical batch characteristics. Based upon the specific input data, a new set of CFD simulations are then prepared and run to validate the final design.

Lastly, BDF is closely focused upon high automation and connectivity. Today the company has developed both and deployed them to offer quick and easy remote diagnostics and assistance to its installation - one more data collecting tool by which to improve the performance and robustness of BDF furnaces.

Here, in conclusion, the company's recipe for the future remains reliable and solid, based upon very high automation together with digital improvement - all to support the CO2 reduction solution within its portfolio. Though the main goal remains that of the Hybrid Furnace, BDF also has a solution for the conditioning zone which includes a full electric forehearth - free of electrode contact with the glass or in the combustion system and forming line. A path now well-traced - all proof, as proven by its history, that the company is no newcomer to this innovative approach to the container glass market. ■