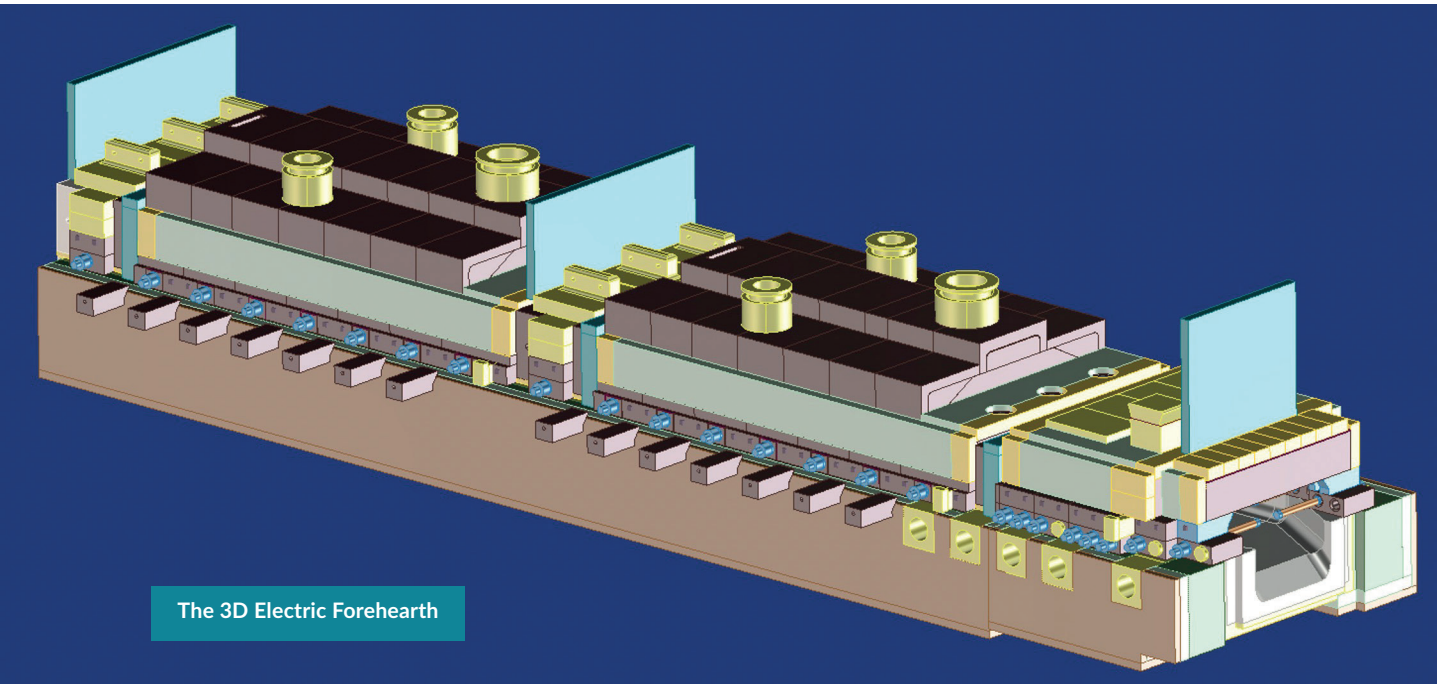
BDF Electric Forehearth signals new era in glass conditioning

A breakthrough in sustainable glass conditioning, the All Electric Radiative Forehearth, introduced by BDF INDUSTRIES, combines advanced thermal control, zero emissions and exceptional energy efficiency. Indeed the innovation marks a pivotal shift away from combustion systems - supporting the glass industry's transition toward greener, cost-effective and future-ready production.

In terms of energy efficiency and environmental sustainability, the glass container industry is continuously evolving to meet modern challenges. As for the forehearth, which BDF considers to be a beneficial area of focus, the transition from traditional combustion-based systems to innovative electric solutions is one area where the company sees the industry being significantly reshaped. Over recent years, global policies aimed at reducing carbon emissions have intensified, with initiatives like the European Green Deal setting ambitious targets for decarbonization. The glass industry, being energy-intensive, is under increasing pressure to adopt cleaner technologies. Regulations such as the EU Emissions Trading System (ETS) and incentives for green industrial transformation are driving manufacturers to rethink their processes. The push toward net-zero emissions aligns with consumer and industry demands for more sustainable production, making innovations like the BDF Electric Radiative Forehearth an essential step forward. The Green Deal not only imposes stricter emissions regulations but also incentivizes industries to transition towards renewable energy sources and electrification of processes. This shift is particularly relevant in the glass industry, where the need for precise thermal control and continuous operation makes conventional energy-intensive solutions less sustainable in the long term. With electricity grids increasingly powered by renewables, electrification presents an opportunity to further reduce the carbon footprint of glass production.

A VENERABLE TRADITION OF INNOVATION

BDF Industries has been a pioneer in glassmaking technology for about 120 years, continuously innovating to meet industry demands. With a strong legacy in designing and manufacturing state-of-the-art melting, forming, and automation solutions, BDF has played a key role in modernizing glass produc-



The 3D Electric Forehearth

tion. Over the decades, the company has introduced groundbreaking advancements in melting systems, thermal conditioning, and energy-efficient solutions that enhance productivity and sustainability.

Some of BDF Melting's most notable innovations include:

- Advanced Combustion Systems: Enhancing efficiency in glass melting and reducing NOx emissions also by means of technology like Natural Gas Continuous analyzer and servo actuated burner support.
- Automation and Process Control Solutions: Integrating digitalization into glass production for increased precision like the BDF Forehearth Close Loop and the Panorama 4.0 suite.
- Hybrid and Electric Melting Technologies: Pioneering alternative solutions to traditional combustion-based glass melting. As well as the installation of an enthalpy recovering system like the ORC plant in container glass.

The development of the All Electric Radiative Forehearth is another testament to BDF's commitment to technological excellence and environmental responsibility.

IMPROVING LEGACY SYSTEMS

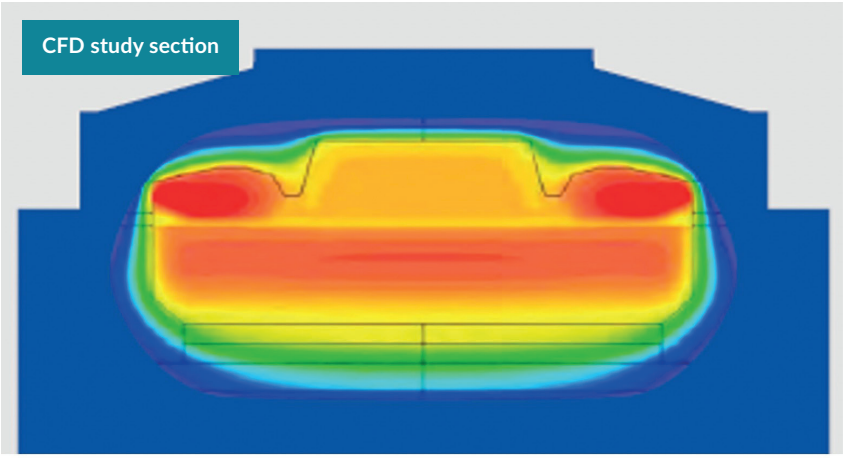
Conventional forehearths rely on combustion, which introduces several challenges:

- Despite technological advancements (e.g., oxygen analyzers, combustion skids), controlling combustion variables remains difficult, leading to inconsistency in glass conditioning.
- Handling flammable gases, particularly LPG, poses some safety risks.
- Combustion generates CO2 emissions and other pollutants. For example, burning 1 kg of CH4 produces approximately 2.75 kg of CO2.
- The combustion process lacks heat recovery, leading to energy waste and increased operational costs.

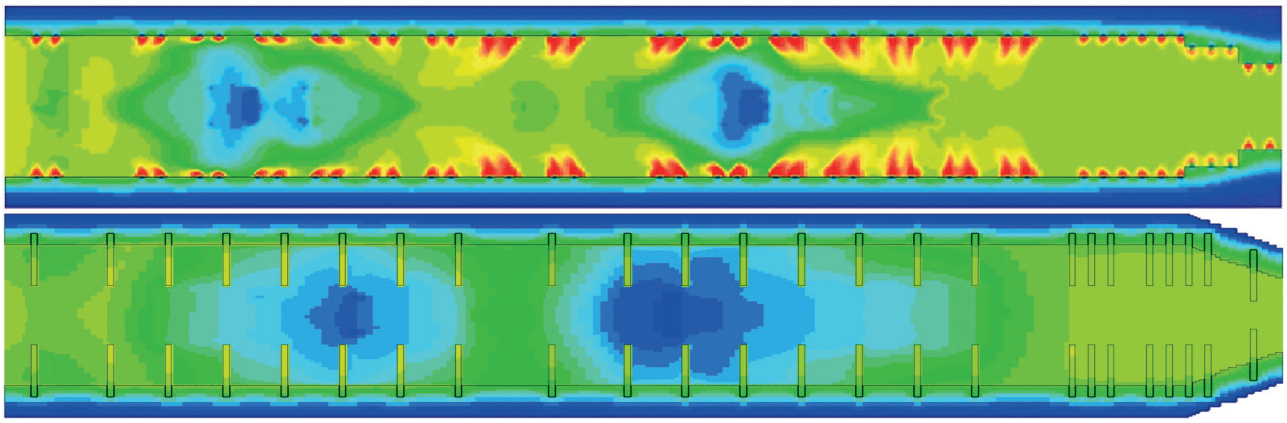
DECARBONIZATION STRATEGY

Reducing CO2 emissions is a priority for the glass industry. While the melter remains the primary source of carbon emissions, improving forehearth efficiency represents a significant step toward overall sustainability. Transitioning to an electric heating system offers a viable strategy to reduce the carbon footprint and support future decarbonization efforts.

Electric heating solutions are



CFD study section



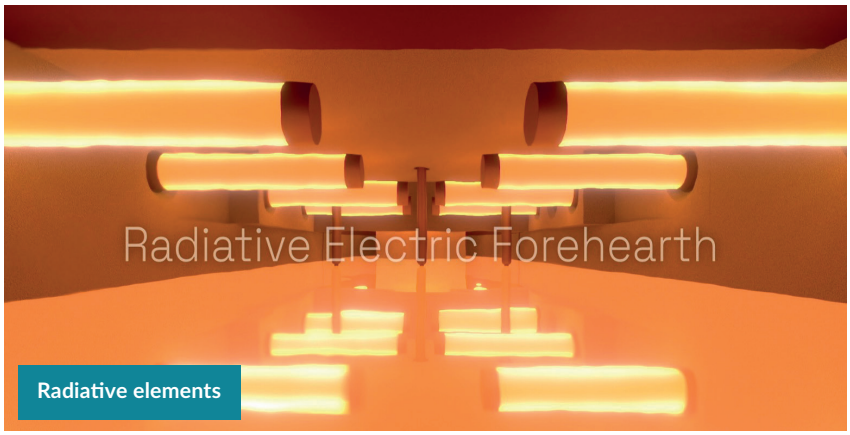
CFD study layout

aligned with the EU's Fit for 55 Package, which aims to reduce greenhouse gas emissions by 55 percent by 2030. As carbon pricing mechanisms become more stringent, glass manufacturers must adopt technologies that ensure compliance while maintaining cost-efficiency. The BDF Electric Forehearth supports this transition by eliminating combustion-related emissions and optimizing thermal control.

THE ALL ELECTRIC RADIATIVE FOREHEARTH

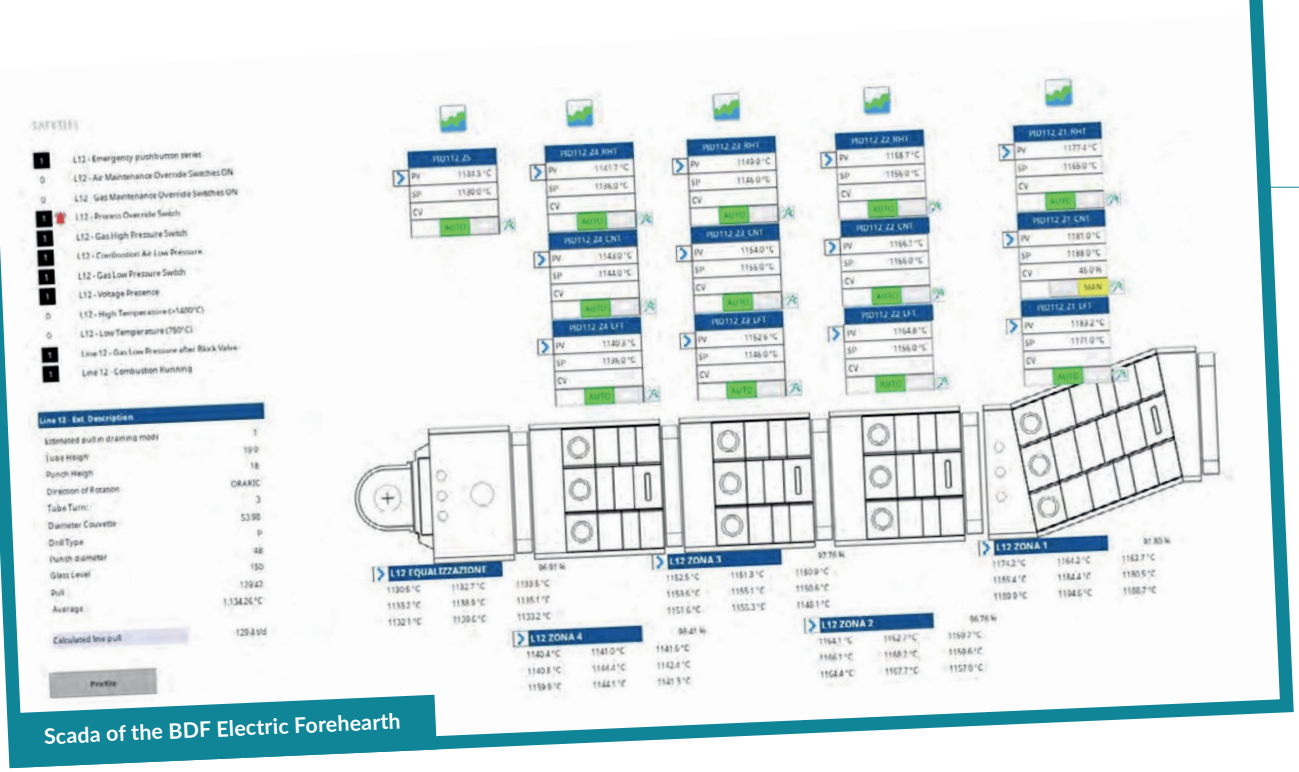
BDF's innovative forehearth solution incorporates electrical heating element technology to transfer energy through radiation. Unlike traditional systems, it does not require electrodes in direct contact with the glass that may cause defects in the articles. Key benefits include:

- Zero Exhaust Losses: Without combustion, there are no exhaust gases, eliminating heat loss and increasing efficiency.
- Superior Temperature Homogeneity: The BDF All Electric Radiative Forehearth ensures a high homogeneity index in the glass. Thanks to an advanced control system using SCR (Silicon Controlled Rectifiers), the system groups a limited number of radiant elements per zone, allowing for side-by-side heating control. This design provides finer and more precise temperature regulation compared to flame-based systems, minimizing thermal gradients and enhancing overall glass quality.
- Significant Energy Savings: A CFD simulation study conducted on a 70 tpd production line, starting at 1250°C and targeting 1120°C, and considering a thermal efficiency of 99 percent. Compared to traditional combustion-based forehearths, this results in an energy consumption reduction in kilowatts of more than 80 percent. The absence of exhaust gas losses and the precise electrical heat control contributes to unparalleled efficiency, leading to both economic and environmental benefits.
- Improved Safety: By removing combustible gases from the process, operational risks are significantly reduced.
- Greater Flexibility: Electric heating allows finer adjustments in



Radiative elements

Control panel of the Radiative elements



Scada of the BDF Electric Forehearth

temperature control, improving glass quality and process stability.

ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY

One of the most compelling aspects of the BDF Electric Forehearth is its dual advantage of economic and environmental sustainability. Traditional systems are subject to fluctuations in natural gas prices and carbon taxation, creating uncertainty in operational costs. By contrast, electric forehearths provide more predictable expenses since they rely on stable electricity pricing and are not subject to carbon penalties.

Moreover, energy efficiency improvements translate into lower energy consumption per ton of glass produced, reducing overall production costs while significantly cutting emissions. This contributes to a lower carbon footprint, supporting the industry's transition to a more sustainable future.

In addition, manufacturers investing in electrification are eligible for green incentives, including funding for low-carbon industrial processes. This further enhances the long-term economic viability of the BDF Electric Forehearth as a preferred solution for glassmakers seeking sustainability without compromising profitability.

UNMATCHED RELIABILITY AND PERFORMANCE

BDF's reputation for reliability and innovation is a key differentiator in the market. The All Electric Radiative Forehearth is designed with advanced monitoring systems that track power absorption in heating elements. This allows operators to anticipate aging and adjust parameters accordingly, ensuring optimal performance with minimal manual intervention.

Additionally, the control system design, robust and intelligent, enhances operational stability, reduces downtime and maintenance cost, due to smooth interchangeability of the elements. These factors make the BDF Electric Forehearth a future-proof solution that aligns with the glass industry's need for efficiency, safety and sustainability.

BDF also offers customized engineering solutions, allowing manufacturers to integrate electric forehearths into existing production lines with minimal disruption. This flexibility ensures a seamless transition to electric heating while maintaining high operational standards.

MERGING TECHNOLOGY WITH SUSTAINABILITY

The BDF Electric Forehearth represents a significant advancement in glass conditioning, offering improved energy efficiency, enhanced safety and environmental benefits. By adopting this technology, glass manufacturers can achieve greater sustainability while reducing long-term operational costs. BDF Industries continues to lead the way in innovative glassmaking solutions, reinforcing its legacy as a trusted partner in the industry's transition toward a greener future. As global policies drive industries toward decarbonization, solutions like the BDF Electric Forehearth are expected to be instrumental in ensuring that the glass sector remains competitive, sustainable and forward-looking. With nearly 120 years of experience, the company reports today that it remains committed to pioneering high-performance, eco-friendly innovations that can set new standards in the industry. ■