

First smart burner for the glass industry

Reed Hendershot discusses how the latest burner from Air Products has the potential to reduce downtime, increase efficiency and improve operations.

Air Products has been supplying oxy-fuel technology to the glass industry since the mid-1970s and the company's Cleanfire* burners have been recognised as leading technology since their introduction in 1991. Over the years, Cleanfire burner technology has been continuously improved (see table 1), leading to the introduction of the first smart burner for the glass industry – the Cleanfire HR_e burner.

The Cleanfire HR_e smart burner represents the evolution of two existing Air Products technologies, beginning with the most widely installed member of the Cleanfire burner family, the HR_i burner. This burner produces a low momentum, high aspect ratio flame that, together with proprietary oxygen staging, can be intelligently tuned to maximise the proportion of key visible and near-infrared radiation delivered to the glass, while minimising radiation delivered to the crown.

Oxygen staging technology facilitates independent flame length adjustments and reduces NO_x emissions, while the burner nozzle design prevents carbon build-up and consequently reduces the frequency of burner maintenance. Additionally, the technology offers high turndown capability and low fluid inlet pressure requirements. The Cleanfire HR_i burner technology is available in gas and oil versions, in sizes ranging from below 0.25 to over 20 MMBtu/h (0.07 to 6 MW). These proven benefits enable the burner to consistently deliver the lowest cost per ton of glass melted.

IMPROVED INTERCONNECTIVITY

In addition to burner technology, Air Products is a leader in all aspects of the generation, storage and use of industrial gases. The company offers a comprehensive service model that includes a telemetry system, which enables Air Products to monitor a customer's gas usage and automatically schedule gas deliveries when needed.

Combining Air Products' burner technology with the remote data access capabilities of its telemetry system has led to the latest Cleanfire innovation - the patent pending Cleanfire HR_e burner. This burner is the first smart burner for the glass industry and part of the Industrial Internet of Things (IIoT). The IIoT is the connecting of industrial devices or 'things' to the internet in order to automate, improve interconnectivity and increase efficiency. Examples of this include building automation for comfort control, industrial plant connectivity and remote access.

The HR_e burner combines the industry leading HR_i burner technology with recent advances in wireless communications and sensor development. It is available for use with both gas and liquid fuels. An overview of the HR_e system is shown in figure 1 and explained in more detail below.

The HR_e burner (shown in figure 2) is a drop-in

1991	Cleanfire Gen I burner, the first maintenance-free oxy-fuel burner for glass
1991	First full oxy-fuel conversion of a large borosilicate furnace
1993	First full oxy-fuel conversion of a large lead TV glass furnace
1994	Cleanfire HR (High Radiation) flat flame burner, the first oxy-fuel burner with directional heating and adjustable staging for glass
1995	First coupled computer model of glass furnace combustion space and glass bath
1997	Cleanfire HR-HFO (Heavy Fuel Oil) flat flame burner, the first oxy-oil burner with directional heating for glass
1997	Cleanfire HR flat flame burner selected as best burner in third-party testing of competitive burners
1997	Converted roll glass furnace to oxy-fuel on the fly
1997	Hot conversion of TV funnel glass furnace to Cleanfire HR burners
1998	First float glass melter (600 TPD) converted to 100% oxy-fuel using Cleanfire HR flat flame burners
1999	20th high-quality glass tank (mainly float) installs Air Products oxy-boost technology
2000	Second float glass melter converted to 100% oxy-fuel using Cleanfire HR flat flame burners
2004	Cleanfire HR, flat flame burner, fuel efficiency further improved
2006	Cleanfire IBL (Integrated Boost & Lancing) furnace system for production increase and low NO _x operation
2008	Cleanfire ThruPort burner for aging furnace life extension and regenerator repair
2014	Cleanfire SF (Solid Fuel) burner, the first oxy-solid fuel burner for glass
2015	Cleanfire HR _e burner, the first smart burner for glass
2016	Coming soon: the next generation Cleanfire HR _e burner to offer new modes of firing with unmatched performance

Table 1: Air Products glass innovation timeline.

replacement for the HR_i burner and communicates information about its status and operating parameters to a local communications hub. The communications and data collection is powered by a long-life battery. This wireless installation provides the advantage of easy installation, without the worry of wires degrading due to the hot environments that are common near glass melting furnaces.

Once the data are collected at the communications panel, the options for data sharing are abundant. The data can, for example, be transferred into the plant's data historian or DCS. In addition, Air Products provides the option of transferring the data to a

cloud-based server that can be used to present the data on a customer-accessible website using any internet connected device and provide SMS/text messaging alerts for any burner parameters outside of normal operation (see figure 3).

Changeover from the HR_i burner to the HR_e burner can be accomplished while the furnace is hot and still producing glass. All preparatory work, such as installation of the communications panel and remote access setup, can be performed beforehand at the convenience of plant personnel. The actual burner change from HR_i to HR_e can be performed by two operators in less than 15 minutes,

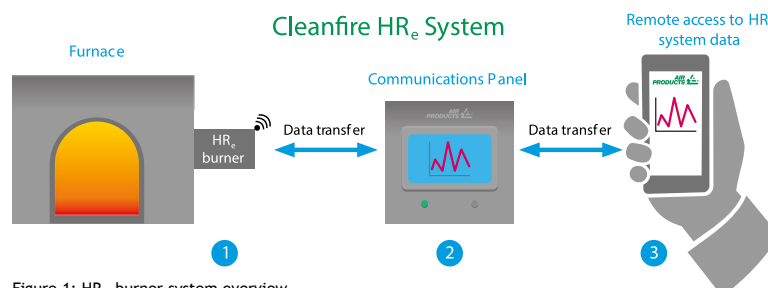


Figure 1: HR_e burner system overview.



Figure 2: HR_e burner installed in a glass plant.



Figure 3: Use of HR_e real-time data.

depending on the furnace environment. Since the burner is battery-powered and communicates wirelessly, once installed, the burner data are immediately accessible both locally and remotely.

The Cleanfire HR_e smart burner monitors pressures, temperatures, positions and battery lifetime. All electronic components are high temperature-compatible and have been tested at elevated temperatures for extended periods to show they perform at the harsh temperatures present near a glass melting furnace. With data provided by the HR_e burner, plant operators are better able to optimise and maintain burner performance and can immediately be made aware of any issues that may arise.

POSITIVE FEEDBACK

The HR_e burner has been field tested at multiple locations around the world, with more installations planned based on initial positive feedback. At one site using an HR_e oil burner, plant operators were able to monitor the need for oil nozzle cleaning based on the information provided by the HR_e system. At another site, HR_e natural gas burners were installed to test data collection and evaluate the potential to improve furnace operation with more precise burner adjustments. The plant had noticed sub-optimal performance in the past and had tried to correct it but was unable to maximise performance with the existing equipment. Once the HR_e burners were installed, the

operators were able to adjust the burner operation setpoints based on real-time data feedback, which immediately yielded improved melter performance and flame properties.

The plant manager and operators at this site and at another installation site, also saw the benefit of the 24/7 data accessibility and alarms, providing them with an increased level of monitoring of their combustion system, even when unattended. These successful field trials demonstrate the benefits of more accurate and continuous burner monitoring and have elevated the performance of melting operations.

The Cleanfire HR_e smart burner seamlessly integrates the industry-leading oxy-fuel HR_i burner technology and the cutting-edge communications capability adapted to the high temperature glass furnace environment. As such, the HR_e burner is a bellwether of things to come, as more smart devices find application in private homes and industrial settings. ■

FOOTNOTE:

**Cleanfire is a registered trademark of Air Products and Chemicals Inc and HR_i and HR_e are grade designations under that trademark.*

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