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Development of Innova-Jet F.H. Oxygen Burner Achieves Significant Energy Savings in Glass Manufacturing Processes

The Innova-Jet F.H. swing oxygen burner developed by Taiyo Nippon Sanso Corporation (TNSC) is capable of directing the flames more evenly over a wider area with a small number of burners via self-induced oscillation, and has achieved significant energy savings at the forehearth in the glass manufacturing processes.

1. Background to Product Development

The forehearth, which adjusts the temperature of the molten glass in the manufacturing processes of container glass and glass fiber, plays a role in distributing the glass melted in the glass melting furnace to a molding machine for molding into a container or fiber. The forehearth has a long tunnel shape. Despite consuming about 10% of the energy of the entire glass melting process, this process has a low thermal efficiency because the exhaust heat is not recovered in the manner of a glass melting furnace.

Like a glass melting furnace, the structure is made of a refractory material, and the internal molten glass is heated by a burner. Compared to the glass melting furnace, the incineration space is restricted. Consequently, we are trying to equalize the temperature of the molten glass by installing a number of small burners with small incineration amounts on the furnace wall.

As a result, we can expect to achieve a significant fuel reduction by switching the incineration method from the existing air incineration method to one of oxygen combustion.

However, ordinary oxygen burners produce less incineration exhaust gas compared to air burners, and the flame temperatures are heightened. As a result, the temperatures near the burner tend to increase locally. In addition, it is necessary to install a short-flame burner in order to lessen damage to the furnace wall when doing combustion in a restricted incineration space.

TNSC has developed the Innova-Jet F.H. burner based on the concept of oxygen combustion for the forehearth using self-induced oscillation.

2. Technical Overview

Self-induced oscillation is a technology that makes use of a fluid phenomenon known as the Coandă effect, in which the flow of a fluid ejected from a nozzle flows along a nearby wall surface. Applied to a burner, this phenomenon causes the flames to change direction in a cyclical manner, increasing the affected area. The design eliminates the need for a mechanical propulsion unit, and creates a simple combustion burner with better maintenance characteristics.

The Innova-Jet Swing burner developed by TNSC uses oxygen combustion via self-induced oscillation. We have already introduced a large number of tundish preheaters as part of the steelmaking processes. (They were released on July 28, 2017.)

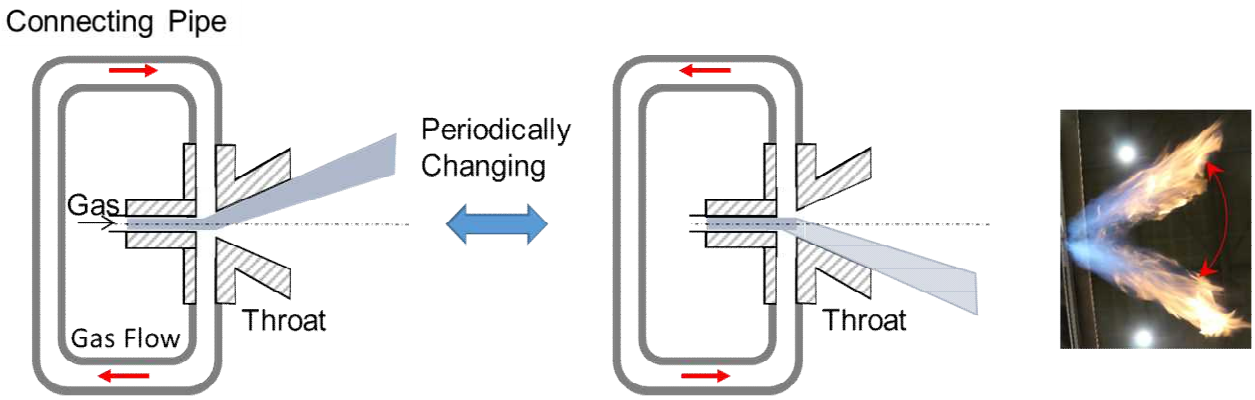

Fig. 1 Structure of self-induced oscillating burner (left), and a photograph of the flames of the Innova-Jet Swing (right)

The Innova-Jet F.H. incorporates a variety of expertise derived from results obtained for the Innova-Jet Swing, and we conducted verification tests using a test furnace that simulates a forehearth in order to apply this expertise to forehearth preheating. Moreover, we worked on the following developments:

(1) Miniaturizing the burner for forehearth applications that require multiple burner-layouts
(2) Minimizing the flame-length changes when the burner incineration amount is adjusted by means of optimizing the swing-cycle of the flame

As a result of measuring the temperature distribution at the bottom of the test furnace, it was confirmed that the same uniform temperature distribution can be obtained even if the number of burners is reduced to less than half of the existing air burners, as shown in Fig. 2. Also, as a result of assessing the thermal efficiency of the test furnace, we confirmed that we had achieved a fuel reduction effect of 65% compared with air combustion (Table 1).

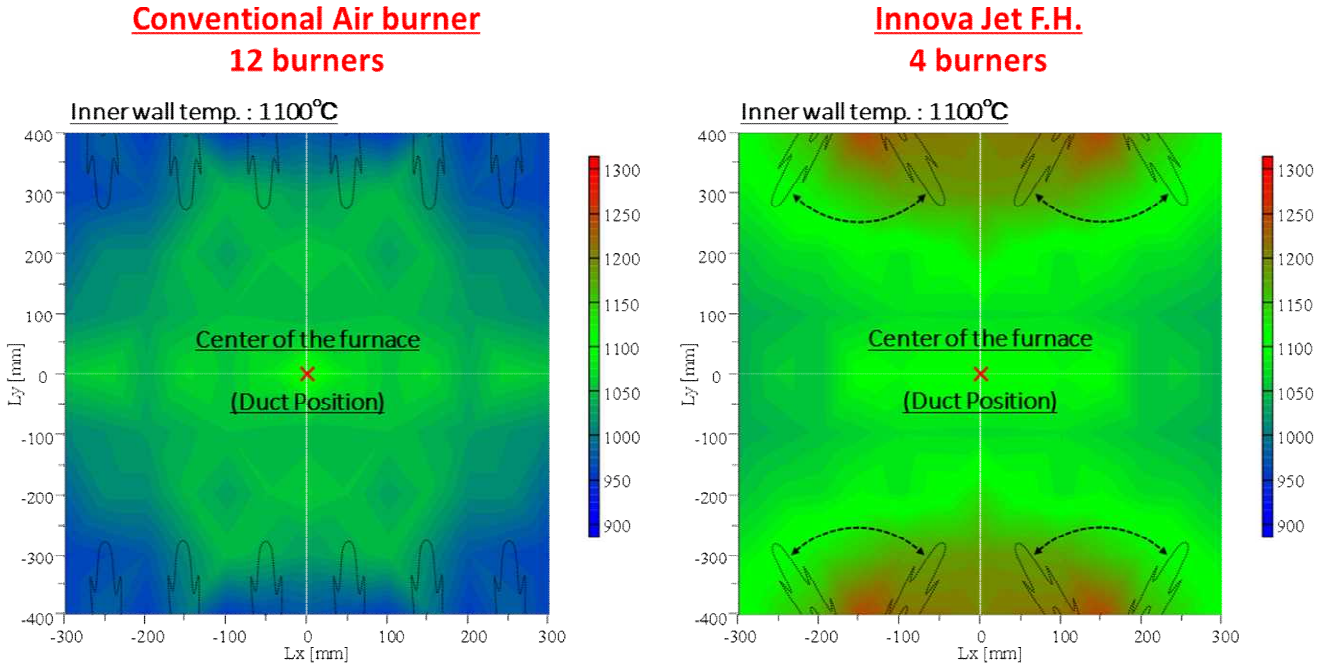

Fig. 2: Temperature distribution in the furnace

Table 1: Effect of reducing fuel consumption

		Conventional	Innova-Jet F.H.
Oxidant		Air	Oxygen
Furnace temp.	[℃]	1100	1100
Fuel	[-]	100	35
Reduction rate	[%]	-	65

*Indicates the value when the amount used in the air burner is 100.

3. Future Developments

Up to now, TNSC has been making technical proposals, including total oxygen combustion and oxygen burner boosting, for the melting processes of glass, in order to achieve improved productivity and energy saving.

The Innova-Jet F.H. is an application for the forehearth to supplement the various energy-saving initiatives that have not been fully employed up to now. As various operations can be improved by reducing fuel, we expect to develop highly efficient oxygen combustion technology for the glass melting processes.

Furthermore, we are developing technology that promises to help save energy and cut carbon dioxide emissions in a range of potential applications in sectors such as steel, glass and ceramics manufacturing.