glass WORLDWIDE

# Enhanced burner design for optimum combustion

Dave Fontes details the development process behind Selas' new oxygen flat flame burner, and explains how the thermal processing specialist is enabling customers to have greater control over the staging flow of gas to the burners.

A pioneer of the thermal processing industry, Selas Heat Technology Company has a combustion heritage that is almost 120 years long. Throughout its history and with its acquired brands, Selas has gathered one of the richest collections of patents in the industry, and the company has invented and engineered many proprietary burners and other technologies – this includes oxygen combustion for glass furnaces and forehearths.

The Selas engineering team has now developed a unique flat flame oxygen burner. The history of the flat flame oxygen burner is well known dating back to the mid-1990s. Several types of these burners produce a relatively thin gas flame front, allowing for quick mixing with the natural gas and oxygen. Other flat flame burner types with relatively higher velocities require staging to be included with the burner in an attempt to delay mixing of the natural gas with the oxygen.

## Improved flame

The design of Selas' Oxygen Flat Flame Staged (OFFS) burner eliminates these issues. First off, the natural gas and oxygen streams have been conditioned within the burner body creating an even flow of both gas streams. Additionally, velocities of the gases have been reduced, below that of traditional flat flame burners. Finally, the natural gas and oxygen profile is thicker or taller than other burners. The lower velocity and thicker stream of the gases produced in the Selas OFFS delays mixing between the inner natural gas core and the surrounding oxygen. This delay in mixing results in a highly luminous radiative base flame without staging. Figure 1 shows the effects of this design improvement with the cracking of the natural gas and resulting dark streak in centre core of the flame.

To enhance the flame further, Selas has developed a completely new staging concept. Injection of the staged oxygen is fully separated from the main burner body. This offers several improvements compared to current burners. First, cross flow of the gases between the staging oxygen and the flame is eliminated with this

Selas' Oxygen Flat Flame Staged burner in block.

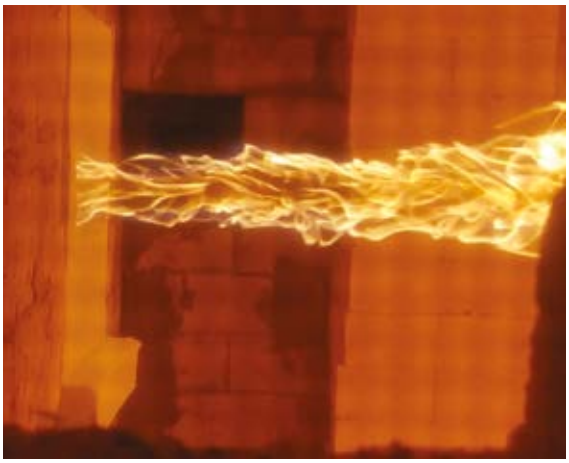

Figure1: The thicker flame root shows strong development for high radiative flux.

| Selas Model | Capacity mm BTU | | Capacity KW | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| 0250 | 0.5 | 2.5 | 147 | 733 |
| 0500 | 1.0 | 5.0 | 293 | 1465 |
| 1000 | 2.0 | 10.0 | 586 | 2931 |
| 1500 | 3.0 | 15.0 | 879 | 4396 |
| 2000 | 5.0 | 20.0 | 1465 | 5861 |

Table 1: Burner Capacities
The Selas' Oxygen Flat Flame Staged burner is available in five capacities.

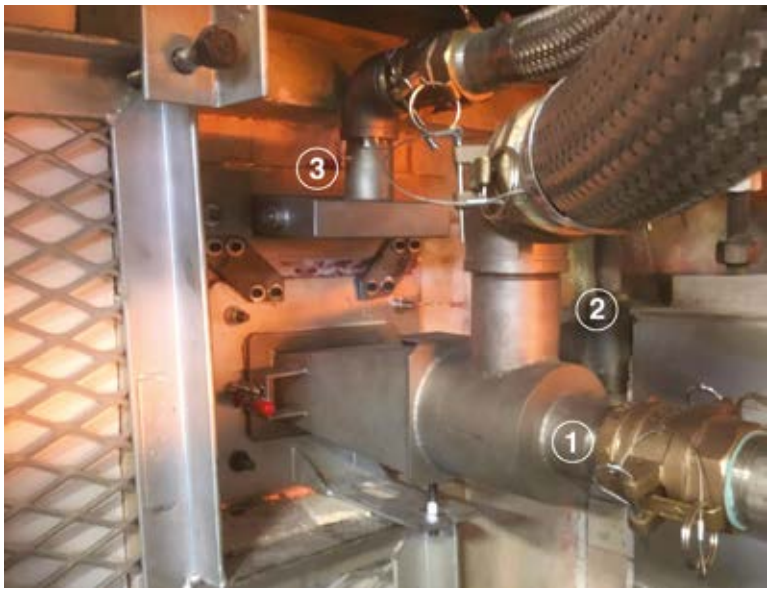


Figure 2: Gas inlet (1), primary oxygen inlet (2) and staged inlet (3) to the burner.

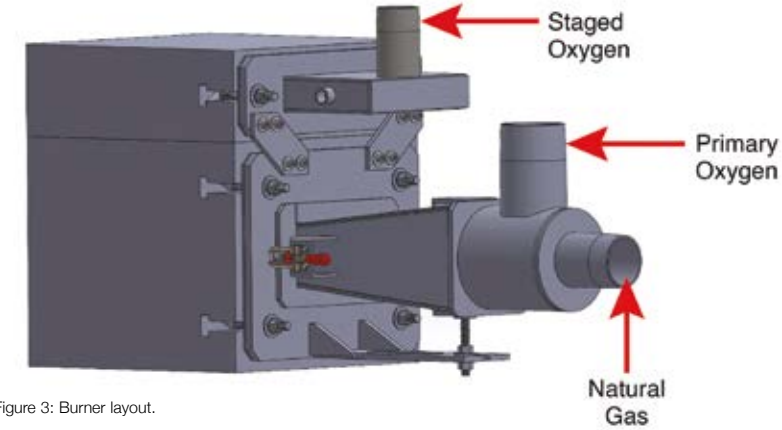


Figure 3: Burner layout.

design. Whereas traditional staged burners have had cracking between the staging and flame portions of the blocks resulting in block damage, this issue is eliminated with the Selas burner. Second, the staging oxygen injection being separated and at a further distance from the flame and burner enhances the delay in mixing, resulting in improved staging effects. Lastly, there is an added benefit of being able to completely automate the staging flow. In figures 2 and 3 you can see the gas inlet (1), primary oxygen inlet (2) and staged inlet (3) to the burner.

## Enhanced staged oxygen control

With the separate staged oxygen design and the ability to control the staged oxygen automatically, Selas has developed 'Enhanced Staged Oxygen Control' or ESOC. This is a new control scheme that not only automates the control of the staged oxygen but provides for varying the amounts of staged oxygen to the burners.

Fedorov and Pilon[1] stated that "pulses of reducing gases (e.g., CO) to the furnace atmosphere was found to be an effective way to destroy secondary foams." Other techniques to reduce foam action mentioned by the authors included "an increase in the furnace atmosphere/flame temperature," as well as "pressure fluctuations."

With Selas' ESOC scheme, making these changes and varying the staging profile from burner to burner is readily achievable. Additionally, with ESOC and today's advanced control systems or 'Smart Controls' it is feasible to adjust the staging amount to vary the flame, moving and adjusting heat input to enhance the melting process.

ESOC can be used on just a pair or several burners. Other burners can be set with 'manual staging' controls. In fact, because of the flexibility of the burner and its design, not all burners in the furnace need to be staged, as the staging process and equipment are completely separated from the main burner itself.

## Versatile set-up

The burner is designed with five capacities, shown in Table 1, to cover any application from small tableware furnaces, borosilicate operations, to fibreglass, larger container furnaces and float operations. The capacities provide wide operational set-up in all applications. The burner can be used with any industrial gas supply and with the low velocities, ultra-low oxygen pressures are not an issue. The customer purchases the burner outright so it is not part of a long-term costly lease.

With the start of the oxygen firing initiative, Selas has pushed our oxygen forehearths into several operations in Asia. Designs are under way for systems in Europe that include both forehearth and melter combustion systems. Selas has also provided an oxygen forehearth system for a container operation. With all this work, Selas has expanded its manufacturing capabilities with enhancements to its operations in Germany, allowing for system and burner support for the European market. ●

1 "Glass Foams: Formation, transport properties, and heat, mass, and radiation transfer", Andrei G. Fedorov, Laurent Pilon, 2002; Journal of Non-Crystalline Solids 311 (2002) pp154–173

About the author:
Dave Fontes is Product Manager, Glass at Selas

Further information:
Selas Heat Technology Company, Ohio, USA
tel: +1 216 662 8800
email: dfontes@selas.com
web: www.selas.com