ローエミッション　フラット　フレーム　バーナー
BOC MAXON LEFF

Neil Simpson
BOC GASES

概　要

BOC 社と Maxon 社は，ガラス製造メーカーが省エネや歩留向上に役立つ新しい槽窯技術の開発を，協力してすすめてきた。マクソン社製酸素燃焼低輻射フラットフレームバーナー（LEFF）の新しい提案は，燃焼技術者により設計され VE 手法により開発された新世代のフラットフレームバーナーである。製造コストの低減と，非常に簡略化された維持管理により，LEFF は今日商業的に使用可能な最も低コストのフラットフレームバーナーである。LEFF は，100％酸素燃焼窯に使用されるように，またあらゆる需要分野でも使えるように設計された。明確な例外があるとすれば，空気燃焼窯での酸素補助燃焼だけであろう。

Introduction

BOC and Maxon Corporation have co-operated in the development of a new furnace technology that expands the options available to glass manufacturers to reduce their energy costs and increase their yield. The new offering, the Maxon Oxy-Therm Low Emission Flat Flame (LEFF), is an advanced generation flat flame burner designed by combustion engineers to be a value-engineered product. Reduced costs of manufacture and significantly reduced maintenance should make LEFF the lowest cost flat flame burner commercially available today.

The LEFF was designed primarily for 100 percent oxy-fuel furnaces and all market segments. Noticeable exceptions would be oxygen boosting of air-fuel furnaces.

1720 Indian Wood Circle, E Maumee, OH 43537
BOC GASES
TEL 419–891–4000
FAX 419–891–4008
E-mail: neil.simpson@us.gases.boc.com

Whilst the LEFF may not be the ideal burner for all glass applications, as part of BOC's portfolio with CGM and Maxon's portfolio with the Oxy-Therm LE, it ensures that combinations of these products can give glass manufacturers the maximum through-put and yield with lowest specific energy.

Development

BOC was the first to develop a flat flame oxy fuel burner for the glass industry. Patented in 1994[1], the first field results were reported in 1994 and 1995 Glass Problems Conferences[2,3]. The broad luminous flame provided enhanced heat transfer with typical energy reduction of five percent compared to traditional tube-in-tube conical oxy-gas burners. Issues of the first generation flat flame burners included sensitivities to turndown, which caused recirculation and led to refractory damage. High capital cost and associated maintenance issues, combined with requirement for an oil

back-up, produced the demand for a next generation flat flame burner.

With a goal of maximising customer value, BOC partnered with Maxon Corporation of Muncie, Indiana to develop the next generation flat flame burner. The partnership brought BOC's vast experience in glass furnace combustion (including its patented Convective Glass Melting (CGM) combustion system[4] and the flat flame oxy-fuel burner) and its dedicated team of experts from the glass industry together with Maxon's proven track record of developing oxy-fuel burners (Maxon having developed one of the first commercialised oxy-fuel burners with Corning in the late 1980's and the highly successful Dual Fuel Low Emission [Oxy-Therm LE] burner in the 1990's).

Built in 2000, the Maxon test furnace shown below (Photo # 1) was used initially to validate the improved heat transfer of the CGM, and also to develop CGM propane and CGM oil. It has also been used in the development of the next generation flat flame burner. Utilising existing BOC patents[1] and Maxon's LE patents[5], the goal of the development was to produce a product with high heat transfer, low emissions and high durability so that it provides the lowest total cost among flat flame burners in terms of purchase and maintenance over the life of the furnace.

Results

Released for field trial in 2001, the final product, the MAXON Oxy-Therm LEFF was first installed in an oxy-fuel container furnace in 2002 (Photo # 2). Possibly uniquely, the LEFF design comprises a single size block which accepts different capacity fuel nozzles. The nozzles are interchangeable without the use of tools and can be drilled to a customer's specific capacity ensuring at least a 5 : 1 turndown at all capacities.

Utilising Maxon's patented staging system, more than half of the oxygen is secondary and introduced to the flame in a staged configuration. With less than half of the oxygen as primary, the heat release and related flame turbulence within the block is low, providing a cool block discharge with low momentum expansion which eliminates recirculation. Avoiding both recirculation and block overheating is the pre-requisite for burner survivability and minimal maintenance. The initial field trial burner operated continuously

Photo 1

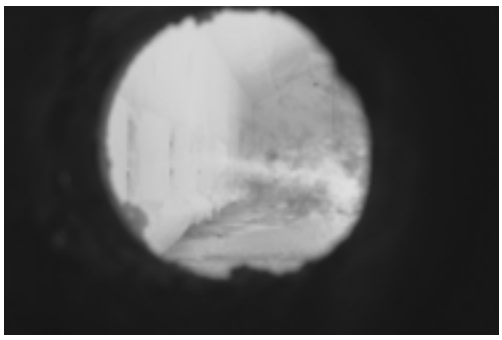

Photo 2

for 8 months and did not requiring cleaning.

While significantly improving durability, the deep staging has an additional two-fold effect of minimising the formation of NOx and improving the heat transfer. The staging delays the rate of mixing and thus lowers the peak flame temperature exiting the burner block by the entrainment of furnace gases. The delayed mixing and higher residence causes the gas to dissociate or ''crack'' forming carbon which improves the luminosity and increases the radiative heat transfer from the flame.

Minimising the combustion taking place within the burner block maximises the flame length and provides increased heat release along its length. Reducing heat release local to the burner minimises the risk of damage to either the breastwalls or the tuckstones.

By lengthening the flame, the width also increases, thereby increasing the total surface area of the flame. The higher surface area provides higher radiative heat transfer to both the glass and superstructure. Extensive testing by BOC and Maxon in three separate dedicated test furnaces (Photo # 3) confirmed the burner has both Lower NOx and higher heat transfer than the original BOC Flat Jet™ developed for the glass industry.

In a further ongoing commercial demonstration in a borosilicate glass furnace, two original BOC Flat Jet burners were replaced with the new LEFF's. There has been both a reduction in energy by several percent and an improvement in quality.

Photo 3

For further information on LEFF and BOC products for the Glass Industry contact:

Neil Simpson neil.simpson@us.gases.boc.com

Scott Wegman scott.wegman@us.gases.boc.com or call 1866 BOC GLASS.

For further information on LEFF and Maxon products for the Glass Industry contact:

Shawn Eldridge ShawnEldridge@maxoncorp.com

Larry Hyland lhyland@maxoncorp.com or call 1765 284 3304

References

1) US Patent 5, 360, 171.
2) Flat Flame Oxy-Fuel Burner Technology for Glass Melting 55th Conference on Glass Problems 1994.
3) High Performance Oxy-Fuel Melting: Three Flat Jet Burner Applications 56th Conference on Glass Problems 1995.
4) US Patents 6, 237, 369 and 6, 422, 041.
5) US Patents 5, 431, 559 and 5, 458, 483.