BURNERS, COMBUSTION AND HEAT TRANSFER

(598) - (*) - NEW TECHNOLOGY FOR ENERGY-EFFICIENT AND ULTRA-LOW NOX ANNEALING OF STEEL

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Increasingly stricter regulations on NOx emissions combined with ongoing efforts to decrease the carbon footprint, demand the steel industry to use further enhanced processes. Linde is a long-term supplier and partner to the steel industry. The successful development and use of Flameless Oxyfuel was originally triggered by needs for reduced NOx emissions. Since its full-scale introduction in 2003, Linde has made more than 400 installations of Flameless Oxyfuel in practically all kinds of steel reheating furnaces, some annealing furnaces, aluminium melting furnaces, and vessel preheating systems.

Currently several steel plants face very strict permits regarding NOx emissions, for example, maximum 70 mg/Nm^3. In dialogue with a large European steel plant, Linde investigated solutions for minimizing NOx emissions at strip annealing in bell furnaces, which lead to a new concept. The technology is patent pending but can already be offered commercially. The design of this inventive new technology was based on fulfilling the following targets:

- Decrease carbon footprint
- Decrease annealing cycle-time
- Improve temperature uniformity
- NOx emissions below 70 mg/Nm^3

Linde's long and successful experience from using Flameless oxyfuel in various applications was used as a basis. Compared to air-fuel heating, it reduces the fuel consumption by 20-60% depending on preconditions and applications. Moreover, Flameless Oxyfuel substantially increases the temperature uniformity.

Bell furnaces have an inner retort where the steel is heated in a protective atmosphere. Between the retort and the outer wall of the bell furnace, there is a narrow space where burners typically are placed heating the retort.

The new and revolutionary concept for energy efficient and ultra-low NOx emissions at bell furnaces, include the following features:

Flue-gasses generated by a Flameless Oxyfuel burner in a chamber adjacent to the bell furnace are recirculated through in the narrow space between the shells of the bell furnace using a high-temperature resistant fan. Part of the flue-gas volume is taken out through a damper to maintain a suitable pressure inside of the bell furnace.

In a retrofit situation, existing burner positions at the bell furnace will be used to disperse the incoming heated flue-gasses creating an extremely uniform heating environment without hot spots on the retort.

The heating process is automatically controlled by the temperature inside of the retort. As heat demand goes up, the Flameless Oxyfuel burner system will add heat to the already used flue-gas returning to the burner chamber by mixing in new flue-gasses.

Furthermore, the protective atmosphere gas will be recirculated through a heat exchanger placed in the system for circulating flue gasses. This will preheat the protective gas and provide a convective contribution to the heating inside of the retort.

The present paper discusses the features and benefits of this new inventive technology, which simultaneously provides very energy-efficient heating – with reduced carbon footprint – and ultra-low NOx emissions meeting increasingly stricter demands in annealing processes. It should be noted that the technology is “hydrogen-ready“, i.e., it can partly or fully use hydrogen as fuel.

Palavras-chave : NOx, flameless, oxyfuel, CO2