9806 Development of an O_2-Enriched Furnace System for Reduced CO_2 and NO_x Emissions for the Steel Industry

Benefits

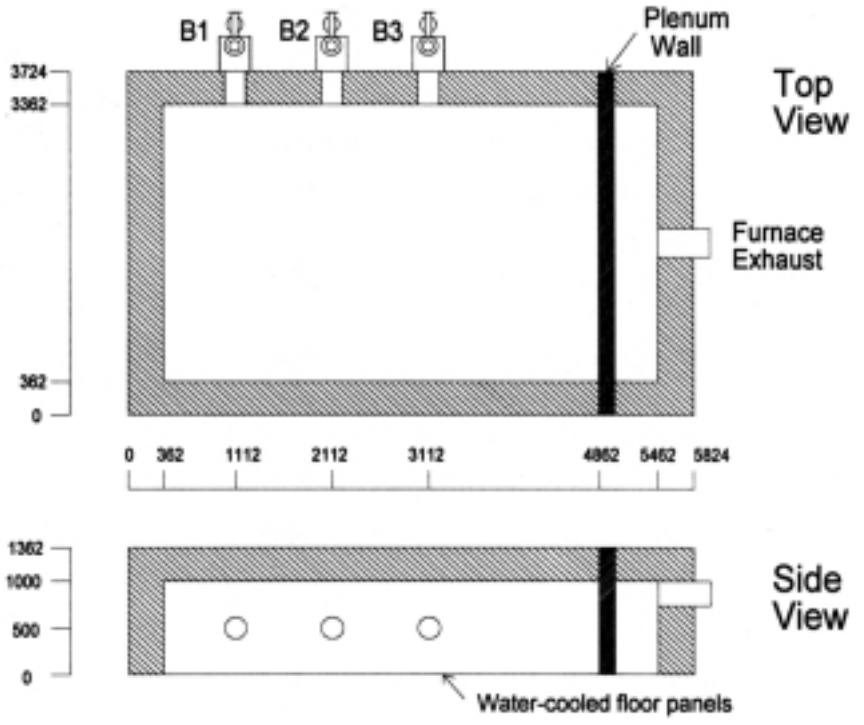
- A burner and combustion technology that produces lower CO_2 and NO_X Emissions.
- Reduced scaling.
- Estimated energy savings 25-30%.

Applications

This O_2 enriched furnace system can be installed in most areas of the steelmaking plant where natural gas is burned, including reheat and blast furnaces.

An O_2-Enriched Furnace System Improves the Energy Efficiency and Reduces the Emissions of CO_2 and NO_X

The most recent approach to reducing NO_X emissions and increasing combustion efficiency involves the use of oxygen-enriched air. In combustion systems, atmospheric nitrogen is the source of almost all NO_X emissions. Therefore if the amount of nitrogen present in burners is lowered, then the amount of NO_X emissions is reduced. At the same time higher flame temperatures are realized, resulting in improved energy efficiency. In oxygen-enriched systems, care must be taken to balance the more rapid NO_X kinetics with the reduced N_2 content in the oxidizing stream. In practice, an intermediate level of N_2 reduction in the oxidizing stream is usually sufficient to reduce NO_X emissions. An added benefit of this technology is that lower fuel requirements produce fewer CO_2 emissions.



Schematic diagram of the CAGCT research furnace showing location of burners (B1 - B3) and primary dimensions (in millimeters).

Project Description

The CAGCT and the Canadian Gas Research Institute (CGRI) have developed an ultra-low NO_X burner for use with natural gas and air. This burner design has been tested under a wide range of operating conditions in the research furnace fired with air and natural gas.

The goals include:

- Determining the optimum design for CGRI-type burners with O_2-enriched combustion.
- Determining the distribution of heat fluxes to a simulated furnace load (floor panels).
- Developing rules of thumb, or empirical correlations, that relate operating conditions such as firing rate and enrichment level to NO_X and CO_2 production.
- Demonstrating the effectiveness of O_2 enriched combustion as a cost-effective technique for reducing NO_X and CO_2 emissions.
- Evaluating the effect of air infiltration on O_2 enriched combustion using a CGRI-type burner.
- Developing rules of thumb that will predict the effect of air infiltration on NO_X emissions.
- Measurements of the rate of scaling of steel billets under various operating conditions with O_2 enriched combustion.
- Recommendations for the optimum operating conditions that minimize scaling while maintaining low NO_X and high combustion efficiency.

Progress and Milestones

- Project start date, January 2000
- Project finish date, January 2001
- CAGCT furnace has been equipped with a new control system and oxygen supply train for O_2-enriched combustion studies.
- Furnace trials have been performed over a complete range of O_2-enriched levels (0-100%).
- Emission rates of NO_X/CO_2 and firing rate have been monitored as indicators of furnace performance.
- Variables examined include the effect of burner geometry, heat transfer load, stack O_2 concentration and the effect of air infiltration.
- Tests for steel scaling at selected operating conditions have been completed as part of the furnace trials.
- Final report is in preparation.

Total Project Cost/Duration:

$172,000/two years.

Research Organization

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