ALUMINUM

Project Fact Sheet

High-Efficiency, High-Capacity, Low-NO_x Aluminum Melting Using Oxygen-Enhanced Combustion

Benefits

The potential benefits of this project relative to air-fuel operation include:

- production rate increases 30 percent
- energy consumption decreases 40 percent
- decrease in production cost per pound of aluminum
- reduced CO_2 emissions

Other potential benefits include:

- NO_x emissions below Southern California's target for secondary aluminum smelters
- added operational flexibility

Applications

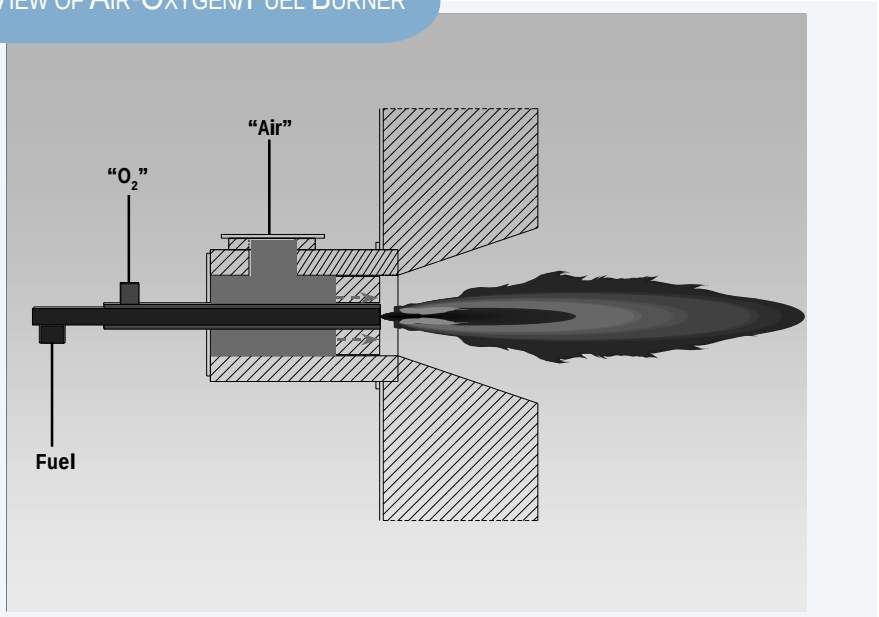
The oxygen-enhanced combustion melting system can be easily retrofitted to reverberatory furnaces commonly used for melting recycled aluminum. Other melting operations that can take advantage of this low-NO_x technology include metal tolling and dross recovery operations and operations that melt zinc, lead, copper and other nonferrous and ferrous metals.

High-capacity melting furnaces will reduce energy consumption, enhance productivity, and lower emissions of NO_x

This project has developed and demonstrated a novel, high-efficiency, high-capacity, low-NO_x combustion system integrated with an innovative low-cost, vacuum-swing-adsorption (VSA) oxygen system. The innovative combustion system uses a novel air-oxy-natural gas burner that achieves high productivity and energy efficiency with low NO_x emissions.

The new technology has been in continuous service since the spring of 1999 at a secondary aluminum melting plant. Measurable milestones of the new technology include a 30 percent increase in furnace productivity and a 40 percent reduction in specific fuel consumption relative to air-fuel operation. The enrichment range of 35 to 50 percent oxygen optimizes burner thermal performance while consuming roughly half the oxygen of traditional oxy-fuel systems. Moreover, field tests have shown that the new burner technology is capable of meeting the aggressive NO_x target of 0.323 lb. NO_2/ton aluminum with minimal CO emissions. The VSA oxygen supply lowers oxygen production costs by employing a unique sieve-filled vessel that stores oxygen during periods of low furnace demand and subsequently delivers it during peak demand periods. This integrated combustion and oxygen supply system will help the U.S. aluminum industry improve the efficiency of traditional melting furnaces, especially those in the aluminum casting sector.

Side View of Air-Oxygen/Fuel Burner



The Air-Oxygen /Fuel Burner provides high-efficiency operation, low natural gas consumption, and great flexibility in operation.

Project Description

Goal: The goal of this project is to increase aluminum melting productivity, energy efficiency and reduce overall melting cost with low pollutant emissions.

This project has been successfully operating since the spring of 1999. The project was carried out in two phases. The first phase included design and construction of the low-NO_x burner optimized for combustion air enriched with 35 to 50 percent oxygen. In the second phase, the onsite VSA oxygen supply system was brought online and integrated into the furnace operation. Use of the proprietary sieve-storage technology allowed for the VSA to be sized for average, rather than peak, furnace oxygen demand. The technology can be retrofitted to existing aluminum melting furnaces. The technology is also adaptable to different configurations, such as direct-charge and side-well reverberatory furnaces but is flexible enough to melt different grades of scrap.

Progress and Milestones

- The low-NO_x burners were installed on a side-well reverberatory furnace at Wabash Alloys' East Syracuse, NY plant in spring, 1999, and have been in service since that time.
- Final performance optimization and characterization for the burners was completed in 1999. The combustion system met or exceeded all project objectives for capacity, energy efficiency and emissions.
- The O_2 VSA with sieve-assisted storage has been online since fall, 1998.
- Performance characterization of the sieve-storage vessel shows that the gaseous oxygen storage capacity is 2.5 times greater than an empty vessel of the same size operating at the same pressure. Extended tests showed that use of the sieve-storage vessel significantly improved VSA oxygen utilization.
- Economic analysis showed that the new air-oxy-fuel technology generates higher operating profits than either air-fuel or oxy-fuel combustion technologies.
- A virtual reality simulation of the combustion process within the Wabash furnace was developed using Argonne National Laboratory's (ANL's) Cave Automated Virtual Environment (CAVE). The CAVE simulation is ready for demonstration at ANL.

Commercialization Plan

- Wabash Alloys has permanently incorporated the technology into Furnace #8 of its East Syracuse, NY plant.
- Due to the success of this demonstration project, Air Products plans to market this technology to the Aluminum Industry and other melting applications. The combustion and O_2 VSA technologies will be offered both separately and in tandem. Proprietary aspects of the technology will be licensed.

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