ALUMINUM

Project Fact Sheet

LOW-DROSS COMBUSTION SYSTEM

BENEFITS

High energy efficiency low-dross production combustion system provides cost and energy savings, environmental advantages, and a significant decrease in dross formation. Specific benefits of this system include:

- reduction in dross generation by 60 percent
- reduction in fuel use by 40 percent
- furnace production increase of 25 percent
- reduction in NOx formation by 60 percent
- SOx, VOC, and particulate reduction of 35 percent
- savings of 1.5×10^{12} Btu annually in the U.S. with a 30 percent conversion of existing reverberatory furnaces

APPLICATIONS

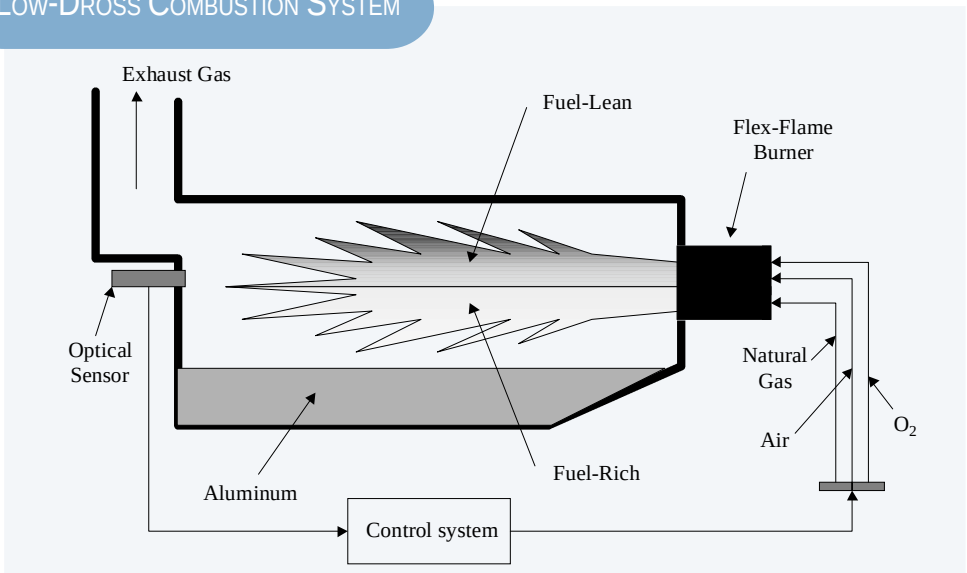
This project is developing a low-dross combustion system that can be installed on new reverberatory furnaces or retrofit to existing industrial furnaces. After successful demonstration of this advanced combustion system, it will be ready for commercial use by aluminum reverberatory furnace manufacturers and operators. This technology would also benefit melting applications in the glass, steel, aluminum, cement, nonferrous metals, and waste processing industries.

HIGH-EFFICIENCY LOW-DROSS COMBUSTION SYSTEM FOR ALUMINUM REVERBERATORY FURNACES

Over 70 percent of 2.3 million tons of secondary aluminum recovered from scrap is processed in reverberatory furnaces. These furnaces are widely used because of their versatility and low capital cost. Despite their benefits, reverberatory furnaces exhibit uneven surface temperature and exposure to oxygen that promotes the production of dross on the surface of the molten aluminum. Dross formation lowers aluminum productivity and insulates the molten aluminum thereby lowering energy efficiency.

This project will develop and demonstrate a high-efficiency low-dross combustion system for secondary aluminum natural gas-fired reverberatory furnaces. Oxygen enrichment is key to improving burner efficiency and has been demonstrated in many industries. Oxygen enriched flames are hotter than air-fired flames and can promote dross formation. However, new burners and controls allow for the control of the flame shape and distribution of oxygen within the flame. Controlling the flame with a fuel rich zone on the flame bottom ensures that the molten aluminum has minimal exposure to oxygen and minimizes dross formation. At the same time, control of the flame shape ensures that the surface is evenly heated. Upon successful completion, this project will decrease energy requirements, improve economics, and decrease gaseous and solid emissions from the remelting of aluminum. This technology can also be retrofitted to existing reverberatory furnaces.

LOW-DROSS COMBUSTION SYSTEM



The high-efficiency low-dross combustion system in operation.

Project Description

Goals: The goal of this project is to develop and demonstrate a high-efficiency low-dross combustion system for reverberatory furnaces used for aluminum remelting. An O_2-enriched combustion system with burners capable of flame shape adjustment will be used to meet this goal. This system will provide significantly greater energy and environmental efficiency than present reverberatory furnace combustion systems.

Progress and Milestones

Year 1

- Conduct laboratory flame testing to determine optimum conditions to create an O_2-enriched axisymmetric flame with a fuel-rich zone and a fuel-lean zone.
- Design and fabricate a burner system incorporating the axisymmetric fuel-rich and fuel-lean flame, the O_2-enriched combustion, and complete flexibility to control flame variables over a wide range of firing rates.
- Verify combustion control with the burner on a laboratory-size furnace and confirm sensor capability to monitor flame shape.
- Prepare an Industrial Adoption Plan that includes defining a marketing strategy and preparing a list of potential aluminum remelting industry customers.

Year 2

- Design and fabricate a 3 MBtu/hr burner for pilot-scale testing.
- Install the pilot-scale burner and a non-intrusive optical flame shape sensor on a pilot-scale furnace. Integrate with a control system capable of changing combustion variables over a range of firing conditions.
- Conduct parametric test series to evaluate the complete high-efficiency low-dross combustion system.
- Select an aluminum remelting reverberatory furnace as a host site for future demonstration testing.
- Extend the Industrial Adoption Plan with an emphasis on identifying as wide of a market as possible.

Year 3

- Complete furnace baseline measurements of heat transfer, fuel use, emissions, and process parameters on the selected commercial aluminum reverberatory furnace.
- Design and fabricate a demonstration-scale combustion system for the host reverberatory furnace.
- Install the demonstration high-efficiency low-dross combustion system on the host reverberatory furnace.
- Conduct a parametric test series to evaluate the complete demonstration-scale high-efficiency low-dross combustion system.
- Finalize the Industrial Adoption Plan and prepare the project Final Report.

Commercialization Plan

Eclipse Combustion will market this technology to the entire aluminum industry and other industries.

- Based on preliminary estimates of economic, energy and environmental benefits, this advanced combustion system will quickly establish a large penetration of the reverberatory furnace market.
- Due to a short five year service life of reverberatory furnaces, the capability to work with furnace manufacturers and designers will further increase sales of the high-efficiency low-dross combustion system.

PROJECT PARTNERS

Gas Technology Institute
Des Plaines, IL

Eclipse Combustion
Rockford, IL

University of Illinois at Chicago
Chicago, IL

Wabash Alloys
Wabash, IN

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Project Information
David M. Rue
Gas Technology Institute
Phone: (847) 768-0508
Fax: (847) 768-0600
david.rue@gastechnology.org

Aluminum Program
Office of Industrial Technologies
Clearinghouse
Phone: (800) 862-2086
clearinghouse@ee.doe.gov
http://www.oit.doe.gov/clearinghouse/

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov.

Visit our home page at www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

November 2000