ALUMINUM

Project Fact Sheet

Reduction of Oxidative Melt Loss

Benefits

The project will identify melt conditions that will significantly reduce the oxidation of aluminum. The potential benefits of this project include:

- estimated annual energy savings in excess of 58 trillion Btu
- lowered cost of aluminum products
- reduced industrial emissions
- significantly increased recycling capability of the aluminum industry

Applications

Fabrication of virtually all finished aluminum products requires a melting step. This project can be applied throughout the primary and secondary aluminum production industries.

Reduction of oxidative melt loss of aluminum and its alloys

Fabrication of virtually all finished aluminum products requires melting. During the melting process, an average of 4% of the input material is lost to oxidation. The lost material takes three forms in the furnace: 1) dross, a mixture of aluminum oxide compounds and aluminum metal typically skimmed from the surface of the melt; 2) inclusions entrained in the molten metal removed by filtration; and 3) oxide sludge found at the bottom of the melt. In the United States, an annual energy loss of approximately 70 trillion Btu results from oxidative melt loss of over 960 million pounds of aluminum. This project will target practices to significantly reduce these losses.

The melt loss project is a collaboration of government, industry, university and National Laboratories. It will identify aluminum melting practices that will increase energy efficiency and decrease material losses. The project will lower the cost of aluminum products, reduce energy consumption, reduce industrial emissions, and significantly increase the recycling capability of the aluminum industry. An increased fundamental understanding of the oxidation of molten aluminum will be developed to be a cross-section of the aluminum industry.

Skimming Operation



Skimming operation for the removal of dross from an aluminum melting furnace.

Project Description

Goals: The objective of this project is to achieve a 50% reduction in oxidative melt loss, a reduction in dross from 4% to 2%. The research will accomplish this objective by careful control of melt exposure to the furnace atmosphere, through the use of minor alloying elements that dramatically affect the kinetics of oxide growth, and by decreasing the melt surface/furnace atmospheric interface through various barrier techniques.

Progress and Milestones

- Establish sampling procedures, tagging methods, archival storage, and web based access to sample information.
- Prepare industrial alloy standard materials for testing.
- Characterize cast alloy samples for both average composition and variability among samples.
- Analyze dross specimens from actual industrial melting processes to 1) determine effects of variations in melt chemistry on dross formation, composition, and morphology; 2) establish general tendencies of elemental partitioning to dross; and 3) identify mechanisms for breakdown of protective alumina film on melt.
- Use average composition aluminum ingots in test studies to monitor the kinetics of oxide formation.
- Compare test generated dross compositions with the industrial samples.
- Use kinetic studies conducted to time the transition between 2-D to 3-D dross growth with the objective of stopping oxidation during the transition.
- Investigate variables for specific alloys that have a large effect on dross growth rate.
- Determine the effect of decreasing the melt exposure to atmosphere with the intent of delaying 2-D to 3-D growth phase transition beyond typical melt cycle times.
- Use industrial melt batches to validate dross limitation steps and to demonstrate that laboratory-scale studies accurately model conditions in industrial furnaces.
- Model the thermodynamics, heat transfer, and diffusion during melting and oxidation of aluminum laboratory experiments and industrial furnaces.

Commercialization Plan

This project is key to improved technology that will have a direct impact on energy costs, environmental impact and future economics. The companies involved intend to implement the knowledge as it develops directly into their own plants. Since there are several companies involved, the likelihood of commercial implementation is very high.

The National Laboratories and University participating in the project include:

- Albany Research Center, Albany, OR
- Argonne National Laboratory, Argonne, IL
- Oak Ridge National Laboratory, Oak Ridge, TN
- University of Kentucky, Lexington, KY



Project Partners

Secat, Incorporated
Lexington, KY

Alcan Aluminum Corporation
Cleveland, OH

ARCO Aluminum, Incorporated
Louisville, KY

Commonwealth Aluminum
Louisville, KY

Hydro Aluminum
Louisville, KY

IMCO Recycling, Incorporated
Irving, TX

Logan Aluminum, Incorporated
Russellville, KY

McCook Metals L.L.C.
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December 2000