ALUMINUM

Project Fact Sheet

Gas Fluxing of Aluminum

Benefits

The energy and environmental benefits of this project include:

- Reducing energy by 8.4 billion Btu/year by the year 2010
- Reducing chlorine usage from approximately 1.3 to 0.4 pounds per ton of aluminum
- Reducing industry-wide greenhouse gases by approximately 1,377 tons/year by the year 2010
- Reducing bag-house and wet scrubber requirements for emission control
- Reduction of maintenance costs

Applications

Gas fluxing is commonplace in both primary and secondary aluminum industries, as well as large aluminum foundries. This research seeks better ways to remove impurities from aluminum in both primary aluminum production and the recycling of consumer scrap.

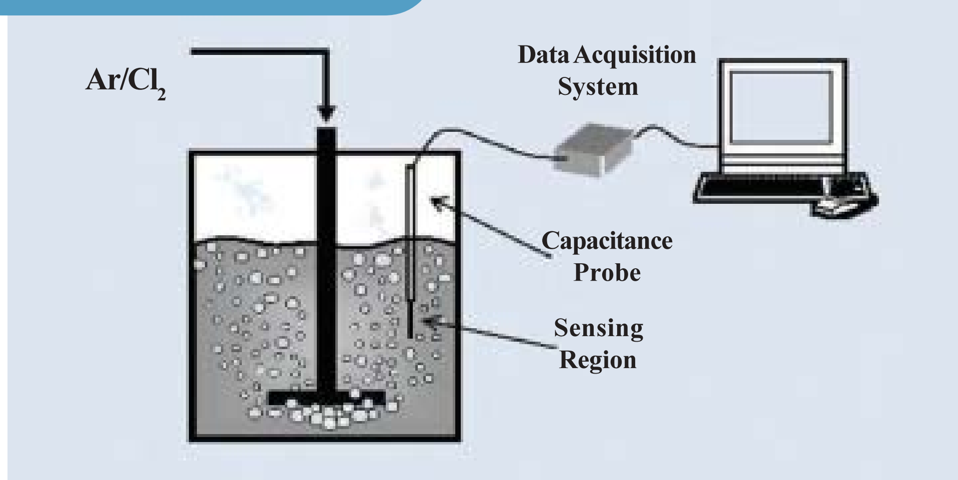
A bubble probe for optimization of bubble distribution and minimization of splashing/droplet formation

Primary and secondary aluminum producers and foundries remove impurities from aluminum by bubbling chlorine through the molten metal as a reactive fluxing gas. An example of the application chlorine fluxing is the removal of magnesium from close to 64 billion recycled aluminum cans (2 billion pounds of aluminum) annually to match the high purity that is representative of aluminum produced from electrolytic cells. Primary aluminum producers also use gas fluxing to remove trace alkali metals from the electrolyte in the electrolytic cells.

One significant problem with this process is that chlorine bubbling is poorly controlled. Excess chlorine is used to ensure impurities are reduced to acceptable levels, which results in both the loss of aluminum ($AlCl_3$) and the emission of oxide fumes and toxic gases. Optimizing fluxing gas bubble size, frequency and residence time would substantially reduce chlorine usage, increase productivity and thermal efficiency of aluminum purification process, and reduce toxic gas emissions.

It is also important to improve the understanding of how gas throughput may be increased without splashing and spraying of molten metal as the bubbles burst at surface. Studying the fluxing gas bubble characteristics in molten aluminum at 1,000 ^{o}K requires special techniques and equipment. A laboratory-scale capacitance probe, previously developed for measuring bubble size, frequency, and velocity in liquid aluminum, will be used to study bubble dispersion of industrial-scale gas fluxing units. The industrial data will be used to advance existing mathematical models for fluxing. Laboratory investigations of bubble bursting will be conducted to optimize fluxing unit performance and to contribute to development future units.

Gas Fluxing



Schematic of capacitance probe used to study bubble dispersion.

Project Description

Goals: The objective of this research is to optimize the gas fluxing of liquid aluminum, which will result in an increase in the throughput of commercial fluxing units, more efficient use of the chlorine used for fluxing, conservation of energy, and minimization of emissions of chlorine/chlorides.

Progress and Milestones

Year One

- Use a previously developed laboratory scale capacitance probe to map bubble dispersion in an industrial-scale fluxing unit under a variety of industrial conditions.
- Extend the mathematical model for laboratory gas fluxing to one style of commercial fluxing unit.
- Initiate laboratory-scale work on fluxing efficiency impact of spraying and splashing of liquid metal by the injected gas.

Year Two

- Extend bubble measurements to other commercial fluxing units operated under as many process conditions as possible.
- Use bubble measurement results to modify a mathematical model, and test the model against plant data.
- Complete laboratory work on spraying and splashing, and initiate investigation of these phenomena at the commercial scale.

Year Three

- Conduct commercial-scale investigation of splashing and spraying from bursting bubbles.
- Predict the optimum design and operating conditions for the existing and new fluxing units by using the mathematical model.

Commercialization Plan

The results of this research will be available in the open literature, which will facilitate commercialization of this approach. The University of California's Office of Technology Transfer will handle patenting and licensing opportunities that arise from this research.

Project Partners

University of California - Berkeley
Berkeley, CA

Alcoa Technical Center
Alcoa Center, PA

For additional information, please contact:

Project Information
James W. Evans
University of California - Berkeley
Phone: (510) 642-3807
Fax: (510) 642-9164
evans@socrates.berkeley.edu

Aluminum Program
Ramesh C. Jain
Office of Industrial Technologies
Phone: (202) 586-2381
Fax: (202) 586-1658
ramesh.jain@ee.doe.gov

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

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

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