

Advanced Scalable Clean Aluminum Melting Systems

Overview

Most aluminum is currently melted in large natural gas or fuel oil fired reverberatory furnaces which suffer from low energy efficiency and enhanced oxidation of the aluminum melt surface, resulting in metal loss through dross formation. Alternative melting approaches, particularly immersion melting, offer the prospect of much higher energy efficiency and reduced melt loss. With the commercial availability of and further new developments in both gas-fired and electrical immersion heaters, the prospect of clean, energy-efficient melting of aluminum on a large scale is increasingly promising.

A key barrier to implementation of clean melting systems is the presence of substantial existing installed capital based on radiant burner technology and its derivatives, requiring an economical approach to technology insertion. In the case of very large melting systems, retrofitting of existing furnaces is likely to be the most viable method, while for smaller units, replacement with an optimized furnace designed for immersion heating could be justified. Currently, however, the technology to enable either a retrofit or new furnace design does not exist.

The project will develop and validate the technology elements necessary to enable to implementation of immersion melting over a range of furnace sizes and product melting requirements. The initial engineering focus will be on utilizing commercially available immersion heating products combined with metal recirculation units to provide the necessary heat flux for melting and heating but also metal movement for temperature uniformity. Concurrently, models of mass and heat transfer and metal flow will be constructed to assist in the sizing and location of the heater and circulation components for application in various furnace configurations with different melting requirements, ranging from light scrap to sows and heavy scrap. Demonstration and validation will be carried out in a pilot scale 2,000-pound melting furnace. One output of the project will be a set of design guidelines for implementing the clean melting technologies, either in a retrofit or new design mode.

The project team brings together the engineering and design capabilities of technology organizations including Enercon Systems and E3M, Inc. with the modeling and analysis capabilities of Oak Ridge National Laboratories, Albany Research Center, and the University of Kentucky. Secat, Inc. will lead the project and provide industrial implementation assistance. With a strong contribution from the project's industrial partners including equipment suppliers as well as end users in the metalcasting and integrated aluminum processing sectors (Wise Alloys, Logan Aluminum, and Trace Die Casting), commercially implementable technology development will be enhanced.

The significant reduction of dross formation and improved melting efficiency made possible by this project will result in significant energy and environmental benefits that surpass those that can be made from further improvements in conventional melting technologies.