ALUMINUM

Project Fact Sheet

Structural Factors Affecting Formability

Benefits

Full-scale implementation of this continuous casting research would lead to:

- 25 percent energy savings in the production of aluminum sheet products compared to conventional direct chill (DC) casting
- yearly energy savings of 23 trillion Btu and related energy cost savings of $96 million per year for the U.S. aluminum rolled products industry by the year 2015
- 14 percent less total conversion cost for the continuous cast than for the DC cast
- elimination of energy-intensive processing operations including scalping, ingot sawing, homogenization, and reversing mill ingot breakdown
- avoided energy content losses that result from melt losses in remelting scalper chips
- reduced levels of CO_2 and NO_x emissions

Applications

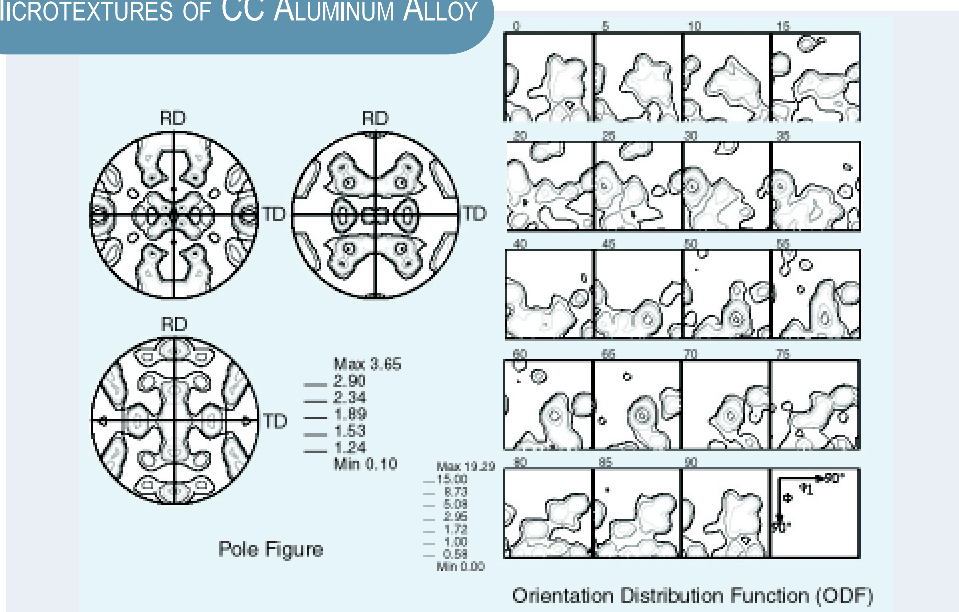
The research is appropriate for the domestic aluminum industry as it will result in improved aluminum processing capabilities and thus lead to greater use of aluminum in various industries.

Fundamental Studies of Structural Factors Affecting the Formability of Continuous Cast Aluminum Alloys

Aluminum sheets made by continuous casting (CC) provide an energy savings of at least 25 percent and an economic savings of more than 14 percent over sheets made from direct chill (DC) cast ingots. Width and formability are among the most important characteristics of aluminum sheets. There are substantial differences in the microstructures of CC and DC cast sheets that are a result of the casting process. Understanding the microstructure differences and how these relate to product forming is required before industry will invest the large capital required for wide continuous cast sheet equipment. The ability to continuously cast wide sheets with good formability microstructure will make the energy and economic savings available to a greater portion of the sheet forming market.

The research will focus on determining the influence of the cast microstructure and the spatial distribution of the intermetallic constituents and dispersion phases of the microtexture during deformation and recrystallization. The object of this research is to study in detail the difference in structure between DC and CC aluminum alloys that leads to the difference in formability. This work will concentrate on the 5000 series aluminum alloys, which have great potential for continuous cast product market growth. The difference in formability will be correlated with the difference in bulk texture and microtexture of the two materials. The fundamental insight obtained from this research will provide a science-based approach for optimizing wide continuous casting technology.

Microtextures of CC Aluminum Alloy



Orientation Distribution Function (ODF) result and pole figure for a thermomechanically processed continuous cast aluminum alloy.

Project Description

Goals: The goals of this multi-partner research project are (1) to develop an understanding of the influence of initial microstructure on the evolution of bulk texture and microtexture in 5000 series aluminum alloys during thermo-mechanical processing of continuous cast (CC) material to produce hot bands; (2) to establish basic relationships between formability and microtexture in the CC sheet products; and (3) to quantify the correlation between processing, microstructure and formability.

Progress and Milestones

- Microstructural characterization - Characterize the microstructure, bulk texture and microtexture of material at various stages of the CC processing route.
- Formability studies - Determine the effects of processing variables on the microstructure, texture, mechanical properties, and formability of the sheet.
- Processing - microstructure - formability relationships - Obtain a correlation between processing, microstructure and formability of CC 5000 alloys.
- Modeling - Utilize a metallurgical model for the kinetics of microstructure and texture evolution during thermo-mechanical processing.

Commercialization Plan

Commercial adoption of the fundamental knowledge gained from this program will take place through the active participation of the industrial partners. In particular, Secat, Incorporated is a cooperative of over a dozen industry partners that facilitate research and development of innovative technology and products for the aluminum industry. The "know-how" developed during the project will be transferred to the participating companies continually throughout the project. The participating companies have a clear and direct interest in implementing the technologies developed in the program. In addition, the results of this research will be available in open literature, which will facilitate commercialization.

Project Partners

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Commonwealth Aluminum Company
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Oak Ridge National Laboratory
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