Prediction of Texture and Formability of Continuous Cast AA 5000 and 2000 Series Aluminum Alloy Sheets and Their Quality Improvement

James G. Morris, Chi-Sing Man, and Tongguang Zhai

Abstract

Aluminum sheet produced by continuous casting (CC) provides an energy savings of 25 percent and an economic savings of 14 percent over sheet made from conventional direct chill (DC) cast ingots. With the help of the Light Metals Research Labs (LMRL) at the University of Kentucky, Commonwealth Aluminum Corporation (CAC) has successfully produced CC AA 3000 and 5000 series aluminum alloy sheets using the Hazelett twin-belt technology, which have properties similar to their DC counterparts. The present research project extends the work on 3000 and 5000 series aluminum alloys to the 2000 series age hardenable aluminum alloys, which will be a new venture for both the continuous cast aluminum industry and CAC.

The goal of the proposed research project is to develop a quantitative (mathematical) model for the prediction of the crystallographic texture and formability of CC aluminum alloy sheet as a function of processing parameters. The model will be based on thorough experimental investigation of the evolution of microstructure and texture, and their effects on formability of the alloys. This model will show the effect of alloy composition, hot rolling procedure, homogenization practice as well as annealing temperature on the texture evolution during cold rolling and annealing. It will subsequently allow the prediction of formability both from a mechanical anistropy point of view as well as from a limit strain consideration. It is anticipated that the model will be valuable in the optimization of the processing of continuous cast aluminum alloys and the development of aluminum alloys for industrial thermo-mechanical processing. The objectives of the proposed work are outlined below:

- To study the evolution of microstructure and texture during cold rolling of CC aluminum alloy sheets.
- To study the evolution of microstructure and texture during annealing of hot and cold rolled CC aluminum alloy sheets.
- To study the effect of initial texture and microstructure on the texture evolution in CC aluminum alloys.
- To extend the approach recently advocated by Man and study the effects of texture, grain shape, and precipitate particles on formability and plastic anisotropy of CC aluminum alloy sheets.
- To develop quantitative analytical relations that allow the determination of texture evolutions during the production process of CC aluminum alloy sheets and enable the prediction of formability of these alloy products.