Abstract

Hypereutectic aluminum-silicon (Al-Si) alloys are widely used in the aerospace and automobile industries because of their low density, excellent wear and corrosion resistance, low coefficient of thermal expansion, good strength, and excellent castability. They are used in applications that typically require a combination of light weight and high wear resistance, such as liner-less engine blocks, pistons, and pumps. However, the performance of these alloys depends on the fineness of their cast microstructure, especially dendrite cell size, primary and eutectic silicon particles. In this study, the effects of applied electric current on the cast microstructure of Al-13 wt.% Si and Al-20 wt.% Si were investigated. This involved application of a steady electric current density of about 500 mA/cm² during solidification of laboratory-size ingots in a metal mold. Microscopic examination of the cast ingots with a metallurgical microscope revealed that the applied electric refined the cast microstructure of the hypereutectic Al-Si alloys. Specifically, it appeared that the electric current changed the size distribution of the primary silicon particles by increasing the population of comparatively smaller size particles, although it did not affect the eutectic silicon particles. The applied electric current also decreased the average dendrite cell size. The extent of the observed cast microstructure refinement was less than the reported effects of applied electric current in the technical literature. It was also significantly less than the effects of traditional refinement obtained by addition of strontium and phosphorus to the molten hypereutectic Al-Si alloys prior to casting.