Abstract

Modeling of heat transfer, fluid flow and solidification during high speed twin-roll strip casting process is a helpful tool for the better understanding and control of process parameters related to high speed twin-roll strip casting process. A comprehensive steady state mathematical model of high speed twin-roll strip casting of Al-33wt.% Cu alloy is developed on FLUENT 6.3.16 platform and the validation of the model has been done using Jackson-Hunt theory. The model simultaneously takes into account fluid flow, heat transfer and solidification in the molten pool and variation of physical properties with temperature. Further emphasis has been given on the variation in fluid flow, heat transfer and solidification behavior of the liquid metal in high speed twin-roll strip casting process with variation in the process parameters. Simulation results suggest that, at high casting speeds strips with layered structure can be cast. This has been produced experimentally.

Numerical simulation of transient fluid flow, heat transfer and solidification during the starting of high speed twin-roll casting is carried out to estimate the time required for steady state condition to set in, rejection of the initial length of the strip (due to different microstructure) and solidification front speed during the transient stage. The transient model takes into account free surface of the molten pool and surface tension of the liquid metal. The solidification front speed during the transient stage is expected to be higher, leading to different microstructure. From the results of simulation the transient length of strip, which needs to be rejected for different casting speeds was estimated and the model was experimentally validated using Jackson-Hunt theory. It was found that when the speed is increased beyond 0.7979 m/s up to 3.98 m/s the transient length did not increase appreciably.

Key words: Strip casting; Twin-roll; Solidification; Mathematical modeling, Layered structure; Microstructure; Heat transfer.