Growth and Transition of Dendrites in Steel Strands under Different Electromagnetic Stirring Methods

Engang Wang[1]*, Zhongxin Zhai[1, 2], Zepeng Wang[1, 2]
*egwang@mail.neu.edu.cn
1 Key Laboratory of Electromagnetic Processing of Materials (Ministry of Education), Northeastern University, No. 3-11, Wenhua Road, Shenyang, 110819, P. R. China
2 School of Metallurgy, Northeastern University, No. 3-11, Wenhua Road, Shenyang, 110819, P. R. China

In the final zone of steel solidification, because of the poor fluidity of molten steel and its poor ability to feed the liquid core solidification, it generally bring some central solidification defects such as segregation, porosity, shrinkage hole and crack, especially in the strand of special steel. In this paper, a type of vertical electromagnetic stirring (V-EMS) was proposed to apply in the final solidification zone of special steel strands, such as 1Cr13 stainless steel, GCr15 bearing steel and Incoloy 800 Ni-based corrosion resistant alloy to investigate the growth and transition of dendrites of special steel, and compare its effect with the generally rotary electromagnetic stirring (R-EMS). The mechanism of dendritic growth, columnar-to-equiaxed transition and feeding behavior were analyzed. The research results shown that the V-EMS can generate a loop convection in the longitudinal direction of strand to increase the effective stirring height and width of EMS, which is helpful to the mixing of upper liquid steel with lower melt steel, reduce the temperature gradient of dendrite solidification and increase the equiaxed zone in the centre of strand. Applying the V-EMS, it also promote the feeding capacity of the upper molten steel to the final solidification zone, which is helpful to reduce and eliminate the central solidification defects such as segregation, porosity, shrinkage hole and crack. Moreover the mechanism of dendritic growth and its morphology under different electromagnetic stirring were analyzed.

Acknowledgment
The present work is supported financially by the financial supports by National Nature Science Foundation of China (No. U1760206) and the 111 Project (2.0) of China (No. BP0719037).