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Effect of Mn/S ratio on surface quality in continuous casting of steel

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The required properties and the higher strength demands for steel products have been increasing in recent years, leading to the various production routes and the increase in the content of alloying elements. Furthermore, steel industries are facing pressure to transform their production processes to achieve a carbon-neutral society. In these environmental changes, maintaining and further improving the quality of casts produced by continuous casting are important issues. Since surface quality and defects of casts are known to be closely related to the high-temperature embrittlement of steel, a lot of research has been performed on this phenomenon.

This study focuses on high-temperature embrittlement caused by (Mn, Fe)S. Previous research using Gleeble indicated that the Fe content in (Mn, Fe)S and the size of (Mn, Fe)S precipitated along austenite grain boundaries are critical embrittlement factors [1]. In addition, the result showed that embrittlement did not occur under low strain rate conditions. In the present study, high-temperature embrittlement is evaluated using in-situ material characterization by bending (IMC-B) test [2-4]. The results show that embrittlement occurs even at low strain rate in medium-carbon steel with a low Mn/S ratio. This discrepancy seems to be because of differences between the evaluation methods of Gleeble and IMC-B test.

Furthermore, precipitation simulations of MnS are carried out using MatCalc, which enables kinetic precipitation calculations based on thermodynamic databases and kinetic models[5]. The simulation results are compared with observations by FE-SEM. This comparison provides interpretations of the embrittlement mechanism and strategies for the steel composition and process design to improve the surface quality of casts.

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