Contribution ID: **289** Type: **Oral**

Evolution Behavior of Non-Metallic Inclusions in Al-killed Ti-bearing Ferritic Stainless Steel

Thursday 9 October 2025 12:00 (20 minutes)

High-Cr and Ti-bearing ferritic stainless steel (Ti-FSS) has superior corrosion resistance compared to other steel grades. The Ti-FSS requires not only high corrosion resistance and formability but also superior cleanliness of the cold rolled sheet. Specifically, the cleanliness of Ti-FSS has been improved through the vacuum oxygen decarburization (VOD) and the ladle treatment (LT) processes. Nevertheless, there are still unresolved problems such as large fluctuations in Ti-yield and the formation-removal behavior of non-metallic inclusion (NMI) due to various factors including Al deoxidation practice and slag-metal reactions after Ti alloying. Moreover, TiN and Mg(Al,Ti)2O4 spinel-type inclusions formed in molten steel after Ti alloying causes nozzle clogging and surface defects in the final products. Therefore, it is essential to design the refining slag with excellent inclusion removal rate as well as to optimize the deoxidation practice in VOD process. In the present study, the Ti-yield in the Ti-FSS melt as well as the evolution behavior and number density of NMI in molten steel was investigated by varying input conditions of aluminum and titanium as well as the contents of TiO2 and CaF2 in the slag during the reaction between Ti-FSS melt and VOD slag. As the TiO2 content in the slag increased, the Ti-yield in the molten steel increased and the average Ti2O3 content in the NMI increased after titanium addition. When the Al/Ti input ratio increased, the Ti-yield in the molten steel increased. Also, Mg pick-up from the slag also increased with increasing Al/Ti ratio, resulting in an increase of MgO content in NMI and thus spinel-type inclusions were modified into MgO inclusions. When the CaF2 content in the slag increased, the total dissolution time of NMI decreased due to the decrease in slag viscosity, resulting in a decrease of the number density of NMI in the Ti-FSS.

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Session Classification: Control and modification of the non metallic inclusions

Track Classification: Steelmaking - Oxygen steelmaking