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Effect of Bottom-Blowing on Nitrogen Removal Kinetics in Electric Arc Furnace (EAF) Conditions

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The growing automobile market is expected to drive demand for high-strength exterior panels and electrical steel sheets for motors. These products require precise impurity control to maintain formability and magnetic properties. Nitrogen is a particularly crucial element in determining the mechanical properties of steel. Although higher nitrogen content improves tensile and yield strengths, it reduces elongation, negatively impacting formability. However, in the electric arc furnace (EAF) process, nitrogen from the atmosphere dissolves into the molten steel during melting. This issue arises from the nature of the EAF process, where raw materials are melted using arc heat in an atmospheric environment. Due to these challenges, nitrogen control is typically performed during secondary refining processes such as Vacuum Degassing (VD) and Ruhrstahl-Heraeus (RH) degasser. Recently, several studies have focused on utilizing bottom-blowing technology within the EAF process to effectively remove nitrogen from molten steel. Furthermore, with the increasing adoption of hydrogen-reduced DRI (H2-DRI) in the EAF process as part of the transition to environmentally friendly steelmaking, new challenges in nitrogen removal are emerging. H2-DRI has an extremely low carbon content, leading to insufficient CO gas generation during melting. In traditional EAF processes, CO gas, generated from the reaction between FeO and carbon, plays a crucial role in promoting nitrogen removal. However, as the usage of H2-DRI increases, the lack of a carbon source reduces CO gas formation, thus diminishing the nitrogen removal efficiency. Therefore, the present study aims to investigate the efficiency of nitrogen removal through bottom-blowing in EAF operating conditions. Specifically, the current study examines the effects of injecting Ar/CO2/CO gas mixture as well as carbon content in molten steel on nitrogen removal kinetics.

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