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

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Nitrogen is one of the most influential interstitial elements in steel, as it substantially alters mechanical properties through solid-solution strengthening. While elevated nitrogen levels enhance tensile and yield strengths, it simultaneously reduces elongation and promotes strain aging, thereby degrading formability. However, in the Electric Arc Furnace (EAF) process, nitrogen from the atmosphere dissolves into the molten steel during melting. Due to these challenges, nitrogen control is typically performed during secondary refining processes such as Vacuum Degassing (VD) and Ruhrstahl-Heraeus (RH) degasser. Consequently, reliance on these secondary refining steps increases process time and cost, thereby highlighting the need for methods capable of achieving nitrogen control directly within the EAF. In this context, recent studies have focused on utilizing bottom-blowing technology in the EAF process to improve nitrogen removal 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. In particular, the effects of injecting Ar/CO2/CO gas mixtures and varying carbon content in molten steel on nitrogen removal kinetics were examined.

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