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RH High-efficiency Combined Blowing Denitrification Technology Based on Microbubble Metallurgy

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Reducing carbon emissions in the steel production process poses a significant challenge to the steel industry. Increasing the scrap ratio in converters and adopting the electric arc furnace (EAF) short-route steelmaking are recognized as viable solutions and emerging trends to address this issue. However, effective control of nitrogen content in molten steel resulting from these practices remains unresolved. Vacuum denitrification stands as the primary method for nitrogen removal, but deep nitrogen removal under vacuum has always been difficult to achieve due to the combined effects of the surface-active properties of oxygen and sulfur in molten steel, along with the slow mass transfer and diffusion of nitrogen. One potential solution to this problem lies in blowing hydrogen into the molten steel, using the precipitation of dissolved hydrogen in the form of dispersed micro-hydrogen bubbles during vacuum treatment. This paper delved into the mechanism of RH efficient hydrogen blowing technology for generating micro-hydrogen bubbles to remove nitrogen, examining aspects such as the reactions of hydrogen, oxygen, and sulfur in molten steel, the kinetics of hydrogen dissolution and precipitation, and microbubble metallurgy. This technology addresses challenges, including rapid hydrogen enrichment in molten steel, enhanced nitrogen mass transfer, overcoming the hindrance posed by the enrichment of oxygen and sulfur on bubble surfaces and the vacuum chamber steel surface, and increasing the gas-liquid reaction interface. Consequently, it significantly enhanced the potential for deep denitrification in the RH process.

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