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Study on the Influence of Neutral Gas Fraction in the AOD Process using a 3D Two-Phase CFD Model

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The AOD (Argon Oxygen Decarburization) converter process is a dominant process step in the production of high-quality stainless steel, with gas injection playing a critical role in influencing process efficiency and product quality. This paper focuses on developing a mathematical model for gas injection in the AOD converter process, utilizing advanced Computational Fluid Dynamics (CFD) simulations. The primary objective is to investigate the impact of the argon to oxygen gas ratio on key process parameters, specifically emphasizing jet penetration length, bubble column behaviors, and local steel-gas interactions around the tuyere, all impacting the efficiency of decarburization. The developed AOD model incorporates separate mass, momentum and energy transport equations for the steel and gas phases. Additionally, the model addresses the heat generated from the carbon oxidation reaction effectively estimating variations in gas properties (e.g. gas density) due to this reaction. Notably, this study represents the first consideration of the impact of the argon-oxygen ratio on gas phase properties, including gas-steel interfacial tension and the drag force. This approach can be utilized to simulate the initial state of each decarburization stage during the transition to the subsequent stage. This research brings new knowledge to a gap especially within the framework of the multi-stage gas injection in the AOD decarburization process.

Speaker Country

Belgium

Primary authors: Mr KHOSHAHANG, mohammad (KU Leuven Department of Metallurgy and Materials Engineering); Dr CHENG, Zhongfu (KU Leuven Department of Metallurgy and Materials Engineering); Dr CHAULET, Jérémy (Aperam Research Center); Mr SOETE, Bastien (Aperam Stainless Belgium); Dr LEFEBVRE, Guillaume (Aperam Research Center); Prof. BLANPAIN, Bart (KU Leuven Department of Metallurgy and Materials Engineering); Dr MALFLIET, Annelies (KU Leuven Department of Metallurgy and Materials Engineering)

Presenter: Mr KHOSHAHANG, mohammad (KU Leuven Department of Metallurgy and Materials Engineering)

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