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Innovative Method for Scanning an Electric Arc Furnace and Digital Twin-Based Simulation of the Tapping Process

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The optimization of the tapping process in an EAF (Electric Arc Furnace) is essential for increasing process efficiency and extending the lifespan of refractory materials. Traditional laser scanning methods for assessing furnace geometry are often costly in terms of acquisition. This study explores an innovative approach to scanning an EAF using photogrammetry-based 3D reconstruction, eliminating the need for conventional laser scanning technology. The generated 3D model serves as the foundation for creating a digital twin of the furnace, which is then used to simulate the tapping process with MAGMASOFT®. The simulation focuses on optimizing key process parameters, such as the tilt angle and taphole size to enhance tapping efficiency. Additionally, the impact of refractory wear and maintenance practices on furnace performance is analyzed. Specifically, the study examines how misaligned bricks, excessive gunning material application, and deviations in taphole dimensions influence process stability and refractory lifespan. By integrating real-world scan data with numerical simulations, this approach provides valuable insights into furnace behavior under various conditions. The findings contribute to the optimization of maintenance strategies and operational best practices, enabling steel producers to improve refractory durability and reduce unplanned downtime. This study demonstrates the potential of photogrammetry-based scanning as a cost-effective and accessible alternative to traditional methods, making advanced furnace monitoring and process optimization more practical for industrial applications. The integration of 3D scanning, digital twin modeling, and numerical simulation represents a significant step toward the digitalization and automation of EAF operations, paving the way for increased efficiency and sustainability in steel production.

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