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AI-Powered Cohesive Zone Optimization: Enhancing Efficiency and Stability in Blast Furnaces

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The position of the cohesive zone (CZ) in a blast furnace significantly impacts process efficiency and stability. A lower cohesive zone increases dry burden volume, promoting indirect reduction of iron ore and improving energy efficiency. However, excessive downward movement reduces the distance to the dead man, leading to operational instability, irregular gas flow distribution, unsteady coke supply to the raceway, successive burden slips, and potential productivity losses. Maintaining the cohesive zone within an optimal range is crucial for balancing energy efficiency with stable furnace operation.
To address this challenge, we developed an AI-driven tool designed to estimate the position of the cohesive zone root and provide dynamic control recommendations. By analyzing key operational parameters such as hot blast data, gas utilization, burden distribution, and pressure drop, the system aims to predict cohesive zone behaviour and suggest adjustments to maintain optimal conditions. The tool leverages machine learning models trained on historical furnace data to enhance decision-making and improve process reliability.
This AI-based approach enables proactive control strategies, reducing reliance on empirical adjustments and enhancing process stability. By integrating machine learning with process knowledge, our solution helps operators maximize indirect reduction, optimize fuel consumption, and mitigate risks associated with excessive cohesive zone movement. If successfully deployed, this technology could significantly enhance blast furnace control, offering a data-driven framework to improve energy efficiency, operational stability, and overall ironmaking performance.

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