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Multi-Tiered AI Implementation for Slag Property and Alloy Prediction in EAF Operations: Operational Validation Access Three Steel Producers

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EAF operations face critical variability challenges in scrap mix composition and quality that directly impact slag basicity control and alloy chemistry prediction. Traditional multivariate statistical approaches rely on reactive empirical adjustments where conventional analytical tools reach computational limits for real-time process optimization.

This study presents operational validation of a four-tier AI implementation using Fero Labs' Bayesian machine learning software across three EAF producers: a high-end stainless steel sheet mill, a carbon steel sheet producer, and a structural steel facility. The multi-modal approach integrates scrap yard characterization data, real-time melt plan parameters, charge analysis, and tap measurement validation to provide comprehensive process optimization.

Tier 1: Scrap-based prediction activated immediately upon charge schedule determination, enabling proactive slag basicity and alloy content forecasting before bucket loading.

Tier 2: Real-time charge optimization providing operators with optimal chrome additions during melt progression for stainless operations.

Tier 3: Enhanced prediction accuracy using updated scrap characterization and current melt plan data, enabling precise lime addition adjustments and power-on time optimization.

Tier 4: Automated tap data analysis conducting multivariate correlation analysis across 10+ process dimensions with automated investigation report generation.

Stainless Steel Mill: Chrome content coefficient of variance (CV) reduced from 16% to 13% through multi-stage AI optimization, directly addressing the primary cost driver in high-end stainless production.

Carbon Steel Mill: Slag B3 ratio CV improved from 12% to 6%, achieving 50% stability enhancement through predictive slag characterization.

Structural Steel Mill: AI soft sensor implementation increased slag measurement frequency from 33% to 100% of heats, enabling proactive operations management for previously unmeasured heats.

In addition to improving operational stability, early results indicate slag basicity use case achieved 12% reduction in lime dosing, while charge chrome decrease delivered $2 - 5 per ton in high chrome grades and 1-3 per ton in low chrome grades.

Additionally, adverse event investigation closure time as reported by the engineers was reduced from 1-2 days to under 1 hour through automated multivariate analysis and reports with AI insights. This enabled process engineers to dedicate additional time supporting operations teams with adopting AI workflow, which proved essential for creating a continuous improvement cycle and achieving the process stability improvements demonstrated across all three facilities.

The mills utilize Fero Lab's no-code interface enabling process engineers to independently train and maintain AI models without external support. Browser-based HMI delivers real-time predictions and optimization recommendations directly to operators, facilitating seamless integration with existing EAF control systems.

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