Contribution ID: **416** Type: **Oral Presentation**

Slag Modelling and Design Optimisation for Enhanced Performance in Electric Smelting Furnaces

Thursday 9 October 2025 13:40 (20 minutes)

The ironmaking industry faces increasing pressure to reduce carbon emissions in response to global sustainability initiatives. This has incentivised steelmakers to move away from the traditional Blast Furnace (BF), with an emerging alternative being the Electric Smelting Furnace (ESF). The transition to ESFs will reshape slag management and design, requiring a reassessment of slag properties, such as liquidus and viscosity, and elevating electrical conductivity to a key design parameter. The decline in BF slag production also creates an opportunity for ESF slags to supply the cement industry.
This paper presents a methodology to develop an operating window for optimising slag design based on critical slag properties and evaluates selected slag compositions within this framework. The analysis examines the impact of these slags on raw material consumption, energy use, furnace integrity, and operational costs. It ultimately proposes slag designs that enhance ESF performance by promoting high production intensity and improved impurity distribution. Strategies are also explored to ensure ESF slags meet the requirements for cement production, supporting sustainability in both the ironmaking and cement industries.

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Session Classification: Smelting & Carburization Technologies

Track Classification: Ironmaking - Direct reduction and smelting reduction