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High-speed liquid steel analysis for improved control of primary steelmaking

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Abstract

The proposed study aims to reduce the analysis time for on-site liquid steel characterization, facilitating quicker adjustments in scrap use to enhance steel production efficiency. Reducing the overall analysis time enables steelmakers to better control the primary steelmaking process.

The direct analysis (DA) approach focuses on developing an optimized sampler geometry that provides high-quality, low-temperature steel samples suitable for immediate analysis. Initially, a computational fluid dynamic (CFD) model was developed in MAGMASOFT to analyse the filling and solidification behaviour of the sampler. A parametric study of the simulation model identified optimal geometric and process parameters, which were subsequently validated through experimental back to back testing at industrial applications.

Additionally, an improved optical emission spectroscopy (OES) procedure has been designed to deliver accurate results without prior sample preparation, ensuring compatibility with shop-floor conditions. The DA sampler, however, eliminates the need for surface preparation, significantly reducing sample analysis time compared to conventional devices. Reduced waiting times offer numerous advantages, including faster processing, increased yield, lower energy consumption and efficient production control

Keywords: Optical emission spectroscopy, Direct analysis, Steelmaking, Computational fluid dynamics

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