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Process Chain Sensitivities in Green Steel Production: Tramp Element Impacts on Casting, Reheating and Descaling

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The transition toward low-carbon steelmaking increases the reliance on scrap-based electric arc furnace routes, inevitably introducing higher levels of tramp elements such as Cu and Sn. Because these elements cannot be removed through conventional metallurgical refining, they may influence subsequent process steps. Their distinct oxidation behavior promotes the formation of low-melting, Cu-rich phases during continuous casting and reheating. Even at moderate concentrations, these phases significantly intensify crack formation during casting, increasing both the number and depth of surface defects across a broad temperature range compared to steels free of Cu and Sn. Such defects pose a particular risk in downstream operations, where they can persist depending on reheating conditions. Deep casting-related defects may not be fully removed under standard parameter sets, which in turn hampers descaling efficiency. During reheating, the prolonged exposure promotes the formation of additional Cu-rich phases, which can further degrade surface integrity. As a result, remaining surface irregularities, together with grain boundaries already weakened by Cu phases, can compromise the quality of the final hot-rolled product.
The presentation quantifies the defect sensitivity of Cu- and Sn-containing steels using the in-situ material characterization by bending (IMC-B) test. Purposefully pre-damaged samples were produced to simulate how those defects may affect downstream processing. These specimens were subsequently reheated in a natural-gas combustion atmosphere and descaled under controlled conditions to evaluate the evolution and removability of surface defects. Final surface assessments were conducted using metallographic techniques, enabling correlation between Cu and Sn, defect morphology, reheating behavior, and descaling response.

Author: GAISER, Georg (Montanuniveristaet Leoben)

Co-authors: Prof. BERNHARD, Christian (Montanuniveristaet Leoben); Dr PRESOLY, Peter (Montanuniveristaet Leoben); Mr LITTRINGER, Robert (Montanuniveristaet Leoben); Dr ILIE, Sergiu (voestalpine Stahl GmbH)

Presenter: GAISER, Georg (Montanuniveristaet Leoben)

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