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Green Steel Initiatives Supported by Enhanced Slag Engineering Using High-Alumina Circular Metallurgical Additives

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Desulphurisation in the steel ladle requires a reactive slag with high CaO dissolution. Conventional slag fluxing agents applied during this secondary metallurgical refining step include calcium aluminate additives and fluorspar to maximise the dissolved CaO. However, calcium aluminate additives can have a high carbon footprint due to their energy-intensive production process and the use of fluorspar is associated with both environmental concerns and refractory wear. Stahlwerk Thüringen (Germany) is committed to sustainability, with a green steel strategy that includes reducing resource use and implementing stepwise improvements in process efficiency. To support these initiatives, RHI Magnesita and MIRECO conducted an industrial feasibility study to determine if typical fluxes used during steel desulphurisation in the ladle could be replaced by a high-alumina circular metallurgical additive derived from recycled refractory material. This article describes the metallurgical consulting provided by RHI Magnesita during the trial series, as well as the e-tech slag engineering tools that were used for efficiency optimisation calculations and enabled an appropriate balance between desulphurisation rate, additive application, slag volume, and purging gas consumption to be determined. Furthermore, extensive steel and slag sampling was performed, and the chemical and mineralogical results enabled an in-depth evaluation of the metallurgical process during the sequential replacement of calcium aluminate and fluorspar with a cost-effective, low carbon footprint slag fluxing agent.

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