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Assessment of dephosphoration and desulphurizing capacity of the slag as a function of the firing conditions of the lime

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Optimizing the removal of impurities like phosphorus and sulphur is crucial for producing high-quality steel and enhancing process efficiency. This study systematically assesses how the firing conditions of lime —a primary slag-forming agent—directly influence the dephosphorization and desulphurization capacity of metallurgical slags. A series of controlled laboratory-scale equilibrium experiments were performed to determine the partition ratios of sulphur between hot metal and slag, and of phosphorus between steel and slag. The experimental design utilized slags of identical target chemical composition, but varied the lime component based on its calcination history. Limes produced under different firing temperatures and residence times were characterized for key properties such as reactivity, specific surface area, and crystalline structure.

The results demonstrate a clear and quantifiable dependency of the slag's refining performance on the provenance of the lime. Variations in lime reactivity significantly altered the kinetics and thermodynamic equilibrium of the impurity-removal reactions. Specifically, lime with higher reactivity and tailored microstructure, achieved through optimized firing, promoted more efficient assimilation into the slag, leading to improved sulphide and phosphate capacities. Consequently, the final partition coefficients for both sulphur and phosphorus were markedly enhanced, confirming that lime quality is a critical, yet often overlooked, process variable.

This investigation provides actionable insights for steel producers, emphasizing that precise control over lime manufacturing parameters is not merely a quality concern for the refractory industry, but a powerful lever for metallurgical control. By specifying lime characteristics, plants can achieve deeper impurity removal, reduce flux consumption, and improve slag management, contributing to both economic and environmental sustainability in steelmaking operations.

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